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How to Buy Machine Tools—I

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MUCH has been said about the proper way to buy production equipment. Discussions have taken place at practically all of the various engineering society meetings and various meetings of both machine tool builders and machine tool dealers, yet so far as I know no definite plan or set of instructions has really been issued to guide in the purchase of machine tools. I believe a great deal of good can be accomplished and many industries will benefit greatly if a more systematic method is used in the purchasing of new machine tool or other production equipment.

To make these articles specific we shall treat entirely of the purchasing of new machine tools for an established works or company, and shall not consider the starting of a new plant where all equipment must be purchased. However, the same principles apply in the selection of machine tools for an entirely new venture. We shall try to present a method of investigating the various phases of requesting and purchasing of new machine tools, and also to show the many factors that must be considered in order to provide the right machine tool for the job. It should be understood that what is said about machine tools applies equally well to other types of equipment.

It might be well to review some of the things that usually occur in trying to originate a desire for new machines. In an established shop that is crowded to capacity with production, things occur that delay shipments, increase costs and cause many annoyances, that are very difficult for the shop supervision to explain. If the shop is not modernly equipped with machine tools, these difficulties will be far more pronounced, and when this handicap is recognized by the shop supervision it will naturally create a desire for more up-to-date equipment.

Originating the desire for manufacturing equipment, investigating the desirability of a particular unit, selecting the proper machine for a specific need

The most annoying thing that can happen, when the shop is loaded to production, is the breakdown of some important machine tool. This occurs usually when the machine tool is most needed as it is usually loaded up to its maximum capacity, or maybe even beyond its maximum capacity.

A careful analysis should be made as to the cause for this breakdown. It may be due to overtaxing a machine because of excess requirements on production, or it may be due to improper care on the part of the operator. These conditions should be investigated to prevent a recurrence if it is at all possible to prevent it.

The machine should be analyzed to see whether it is possible to repair it and restore its efficiency and accuracy. If it is not possible to produce satisfactory results in this way, a new machine tool must be purchased to replace it.

The manufacturing concern producing the best quality of goods at the lowest price usually gets the most business. Both high quality and low price depend on having an efficient machine shop. It is always desirable to provide a machine shop with the most efficient equipment from both the high production and quality standpoints. If you find your competitor taking business away from you on a price basis, do not assume that he is cutting prices in order to get the business, for it may be that he has a much more efficient shop than you have and while he is underselling you, yet he may be making as much profit as you are. A thorough investigation should be made of the various operations to discover where improvements can be made in quality and prices reduced by the installation of new machine tools.

In a number of shops with which I have happened to be familiar machine tool conditions have been such that it was difficult to get good mechanics to operate them. A good mechanic naturally desires to produce good work and, if he is not provided with suitable equipment, naturally he will not stay if he can find employment elsewhere. During normal times, he will have no difficulty in finding work in a modern shop. Therefore, shops that are not up to date in equipment will have difficulty in keeping good mechanics.

As a plant expands or is required to

produce more than it had in the past, it is necessary to add machine tool equipment. If this is added in a general way, depending upon the space requirements, etc., after a time, the operations may not be in proper sequence. Therefore, it becomes necessary periodically to make a survey of the sequence of operations and rearrange the facilities to create the best manufacturing conditions. When such a condition is being studied and put into effect, it is desirable to consider replacing any obsolete machine tools that may still be used. While the rearrangement is being made, new machine tool equipment should be provided that will increase the efficiency of the new department.

Much has been said about systematic replacement. This particular item will be discussed more in detail further along in this article; however, systematic replacement contributes materially to originating the desire for new machine tools.

If a product is being manufactured that is very much in demand, it will undoubtedly be necessary to increase the manufacturing facilities. This will be obvious if we consider the size to which some of our manufacturing institutions have expanded. In order to expand to this size, it is necessary to add equipment. Therefore, one of the outstanding reasons for the necessity of new machine tools is increased production.

It is naturally of utmost importance to determine definitely whether a new machine is suitable for any particular operation. Any considerable investment in equipment increases considerably the overhead burden on a department or shop. Many things must be considered to keep this particular investment as low as possible, and therefore the purchaser of equipment must determine definitely before starting any negotiations whether a new machine is necessary.

Proper Forms Effective

The most efficient way, I believe, is through the use of proper forms for requesting and analyzing new machine tools, properly filled out and submitted to those in authority for approval. It is a known fact that where the information must be written out, it usually is more complete and more authentic than when given verbally.

Fig. 1 shows a "Request for Equipment." Note that a definite machine is requested for a definite operation. This form also requires advice as to the disposal of the machine tool which the new machine is replacing. Other information is required to permit the proper

REQUEST FOR EQUIPMENT

Works ..... Dept. ..... 19.....

To. ..... Works Manager. Section..... *Appropriation No. ..... *Item No. .....

*An appropriation of $ ..... is requested for..... (State briefly equipment req'd.)

.....in which an estimated annual saving of $..... is expected.

Equipment to be Replaced	Equipment Desired
Tool No. ..... Date Installed.....	Type.....
Size.....	Size.....
Type.....	Accessories.....
Est. Repair Cost $.....	
Yrs. Service after repairs.....	

*Estimated Installation Costs	**Estimated Details Savings
Est. Mach. Cost $.....	Labor.....
Elec. Equip. Cost $.....	Material.....
Installation Cost $.....	Maintenance.....
Total $.....	Floor Space.....
M. T. & F. $..... P. & I. $ ... Factory Expense. $.....	Total $.....

1. State fully the purpose of proposed equipment.....
2. Will equipment require development .....
3. Date new equipment is required.....
4. *Date motor will be available.....
5. *Date new equipment will be installed .....

.....
(Department Supv. of Tools & Equip.)

.....
(Department Supervisor of Time Study)

Requested by..... Superintendent

Approved by..... Date..... Works Manager

Recommended by..... Date..... Sup't. of Equipment

.....Date..... Asst. to Vice Pres.

NOTE: Tool Supervisors to submit three copies to Manufacturing Equipment Department, one to be returned after all information has been added.

*To be filled in by Equipment Department.
**To be filled in by Time Study Department.

Fig. 1—The Westinghouse form used to request new equipment

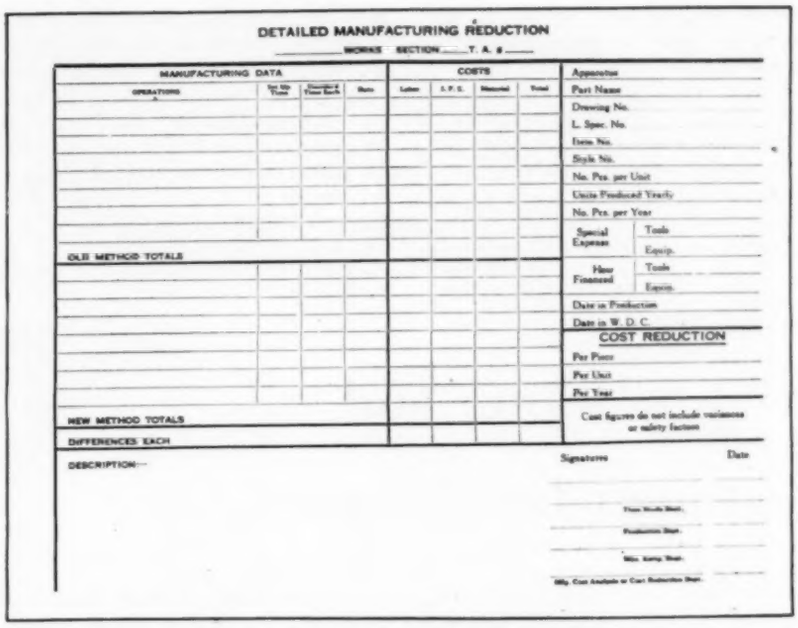
analysis of the results obtained by the investment in a new machine tool. This request is signed by the men responsible for the proper installation of machine tools, which is desirable in order to allocate responsibility.

Fig. 2 shows another form which, I believe, is necessary to show the cost reduction possible with this new equipment. This particular form indicates the old and the new time values, and will definitely show the savings that are possible per piece. Admitting that activity is a variable factor, it is necessary to obtain definite information from the production department or whatever department has this information on production. You will note that this form is approved by those departments that are responsible for productional activities as well as costs.

The proper disposal of a machine that is to be replaced is important. When old machines are allowed to stand around in the shop they take up valuable floor space without doing any good. Therefore, Fig. 3 shows a form of disposition sheet, which when properly executed and passed through the proper people, will dispose of the machine so that it can either be sold or scrapped. Another thing to be remembered is that usually the accounting department charges depreciation on machine tools as long as they are in the department. Therefore, get rid of the old or obsolete machines as quickly as possible to eliminate these depreciation charges.

When selecting a new machine, the method of operating it should be given serious consideration. It is often possible to perform more than one operation on a machine. Therefore, investigate all operations on the product and determine how many of them can be performed on a machine. Then arrange the timing cycle so that the operator will have sufficient time to operate the machine and properly check these operations to insure a satisfactory product.

In shops having high production, it is desirable, especially on long operations, to have an operator run more than one machine. In order to do this, it is necessary that the machine be equipped with adequate stops to insure the machine stopping after the cut has been completed. This provides a safety fac-



DETAILED MANUFACTURING REDUCTION

WORKS SECTION T. A. #

MANUFACTURING DATA

OPERATIONS	Set Up Time	Operation Time Each	Rate	COSTS Labor	L. P. O.	Material	Total
OLD METHOD TOTALS							
NEW METHOD TOTALS							
DIFFERENCES EACH							

Apparatus
Part Name
Drawing No.
L. Spec. No.
Item No.
Style No.
No. Pcs. per Unit
Units Produced Yearly
No. Pcs. per Year
Special Expense: Tools / Equip.
How Financed: Tools / Equip.
Date in Production
Date in W. D. C.

COST REDUCTION

Per Piece
Per Unit
Per Year

Cost figures do not include variances or safety factors

DESCRIPTION:

Signatures Date

Fig. 2 — A form used for determining how much a new machine will reduce costs

MACHINE TOOL RELEASE AND DISPOSITION

Works Date 193

Tool No. Department Section Column

Type and size of machine

Accessories and parts with the machine

Motor No. Belt Drive ☐ Countershaft ☐ Date Machine can be released

No Activity ☐ Replaced ☐ Unsuited to work ☐ Worn out ☐
(Check reason for release)

Remarks

Signed Supt. Tool Supervisor
NOTE—Forward to Mfg. Equipment Dept. with requisition to dispose of machine.

RECOMMENDATIONS

Date Purchased Original Cost $

Condition Est. Cost to repair $ Years Service after repair

Scrap ☐ Reason for scrapping Sell ☐ Reason for selling

Remarks

Signed Demonstrator

Supt. Mfg. Equipment Dept. Date Works Manager Date

WORKS EQUIPMENT DEPARTMENT RECORDS

Move card issued

Sold Scrap sheet authorized $

NOTE—This sheet to be filed with contract in Works Equipment Department.

Fig. 3—When the old machine must be disposed of this form is filled out

tor in case the operator should be busy on another machine. The improvement in efficiency that can be obtained from an arrangement of this kind is surprising. Applications of this character have been made in tool departments where it was thought impossible to have a man operate more than one machine. In addition to giving attention to the consideration of the machine, it is necessary to select work that will get the maximum efficiency from such a set-up. When a man operates more than one machine, the timing cycles on the several machines must be set properly to keep all the machines running at 100 per cent, or as near full time as possible.

Investigate the old machine to see if it can be rebuilt. Although this procedure has worked out satisfactorily in some cases, in the majority of them it has not been so successful. Nevertheless, one should make sure that a new machine is absolutely necessary by investigating what can be done with the old machine before purchasing a new one.

Machine tools are usually purchased because they can pay for themselves in a certain length of time. It is very necessary that information obtained be as accurate as it is possible to obtain it to be sure that a good investment is made. Therefore, a careful analysis must be made of what can be accomplished on the new machine as compared to what can be accomplished on the old one, and estimates worked up as to the length of time to pay for the new machine. Such things as depreciation, interest on investment, resale value of the old equipment, etc., should be considered. This particular subject will be discussed more in detail later on.

Selecting the Right Tool

The selection of the proper machine is really the most important factor in buying machine tools. It is not always desirable to purchase the most expensive machine for a particular operation. If this were true, it would not be difficult to buy machine tools because the most expensive could be purchased and it could be assumed that this was the best for the particular application. But the management usually expects their purchaser of equipment to make the machine tool budgets go as far as possible. Therefore, it is necessary to investigate each particular application and purchase the machine tool that will do that work efficiently and economically. This tool may be a very inexpensive one.

Maintenance must be considered at all times. All machine tools will wear regardless of how they are used. Therefore, it is necessary occasionally to repair or replace certain parts. A great deal of consideration must be given to the method of disassembling and reassembling of new machine tools. It may be necessary to set up a new machine tool in such a location that it may be difficult to take it apart. Therefore, either the location must be changed or the machine should be so arranged that it can be repaired without moving it. There are shops where it is possible to

remove the machine to a centralized location for repair, but in most instances this is not the case.

No manager likes a dirty shop. Machine tools that are difficult to keep clean or contribute to the uncleanliness of the shop are not good machines to install. Operators will not work as efficiently or as accurately if they do not have clean surroundings. Arrangements of machine tools should be such that ample space is provided for the operator and for material that must be brought to and taken away from the machine. The overall dimensions of machine tools must be considered so they will fit into the allocated space.

A distinction should be made between the selection of a machine for a large or a small shop. The small purchaser must be especially sure that what he is buying is right for his job. He cannot move a machine to another location very readily and replace it with one that is more suitable. It will probably be necessary for him to use a machine for many operations which he may not consider at the time of purchase. Therefore the machine must be more or less universal in its application.

Material Selection and Heat-Treatment for Tractors

INTERRUPTION of the steady flow of manufactured product is one of the most serious causes of loss because of lowered shop efficiency, relative increase of fixed charges per unit of product and the loss of sales through nondelivery or slow delivery. It has been the experience of the Caterpillar Tractor Company that even the most diligent study in one's own plant is many times insufficient to bring a remedy for production delays and stoppage unless the cause is traced back to the origin of the material.

Where materials are continually falling short of requirements, it will be found that actual rates are being set for the worst conditions encountered. This was found to be the case for a certain group of nickel-steel gear forgings. Beginning at the steel mill, testing for inherent chemical and physical characteristics before rolling, changing the forging process from batch heating to continuous heating, limiting the size of stock for the upsetting operation, and designing furnaces for controlled heating and cooling rates resulted in the production of a definite and consistent microstructure with a corresponding narrow hardness range, thereby enabling the shop to more than double its previous production rate on the slowest machining operation.

This company takes the following steps in heat-treatment control:

By means of a form captioned "Material Analysis Report," all vendors of steel products intended for heat-treatment supply the inspection and metallurgical departments with complete information as to materials, giving car number, quantity, steel identification and chemistry.

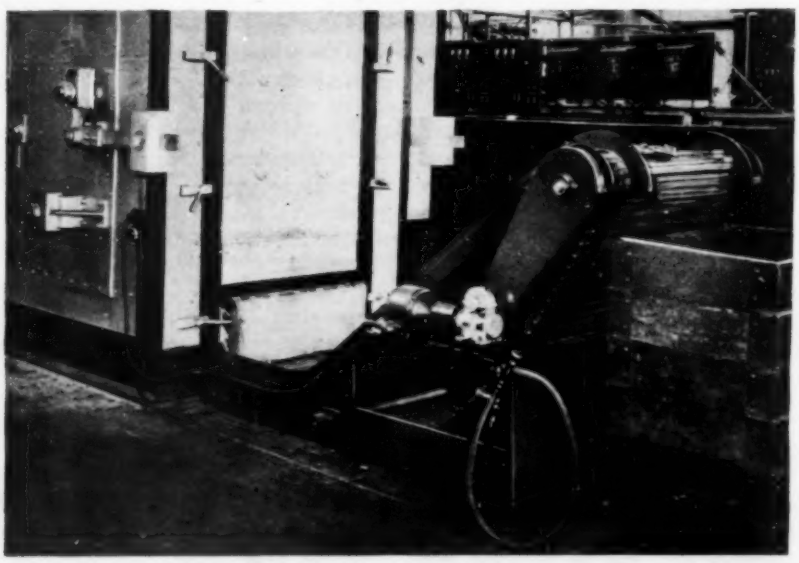
The metallurgical department, having previously passed upon the physical characteristics of the steel thus identified, now confirms and accepts the material. Any special notations concerning heat-treatment are conveyed on a material disposition report.

The parts arrive at the heat-treating department carrying some form of identification and are processed as mill heat lots on which careful records are kept. With some parts, pilot lots are treated to establish quenching times and draw temperatures.

For each part there is prepared a "Heat-Treat and Test Instruction Sheet" on which is given the essential information as to the type of furnace, the method of loading and spacing in the furnace, location of thermocouples, fixtures used in heating and quenching, energy input and regulation, quenching method, medium and time, hardness after quenching, drawing method and time, and the final hardness tests.

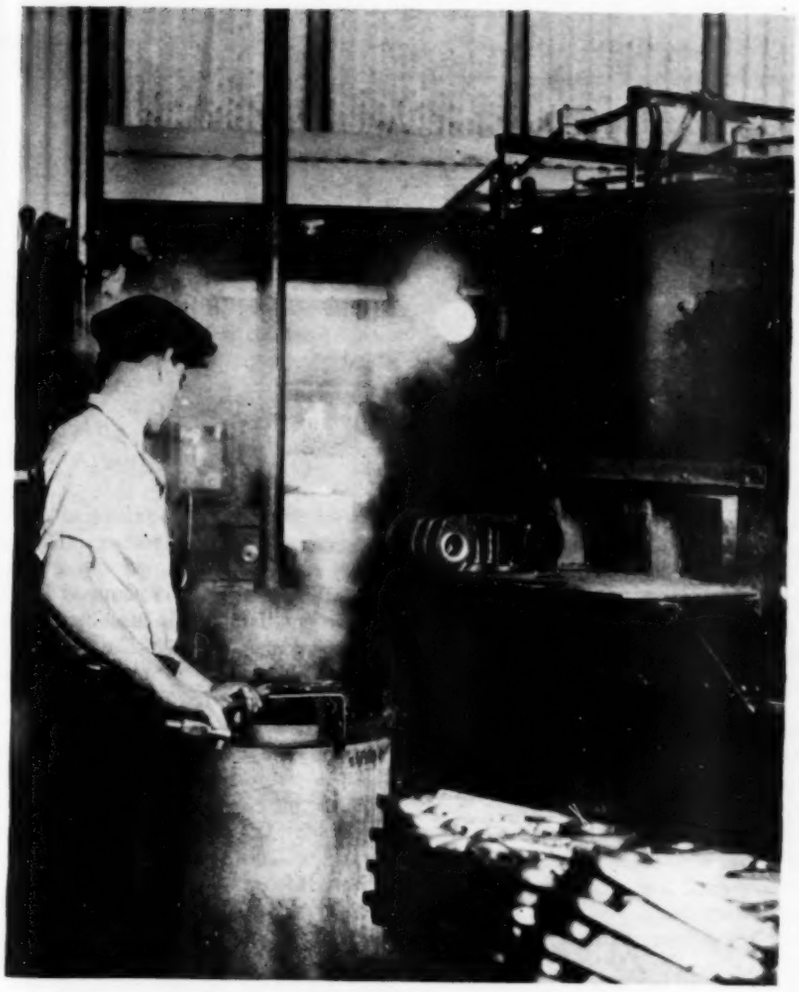
After the final hardness test, a card is filled out giving a permanent record of the individual piece or part performance. The value of these records becomes more emphatic when something shows up wrong with a group of parts from a certain mill heat. The parts, whether finished, semi-finished or rough, can be segregated and held in abeyance while production is sustained by other satisfactory material. From the standpoint of service performance, these records are of great good in running down trouble and improving the product.

More than 100 heat-treating furnaces are used for this work, about 85 per cent of which are electrically energized. The type of installation, the kind of energy and the initial expense are as a rule subordinated to the more important factor of final physical characteristics.



Rear view of a multiple conveyor draw furnace shows the discharge and elevator for delivering links to tote boxes

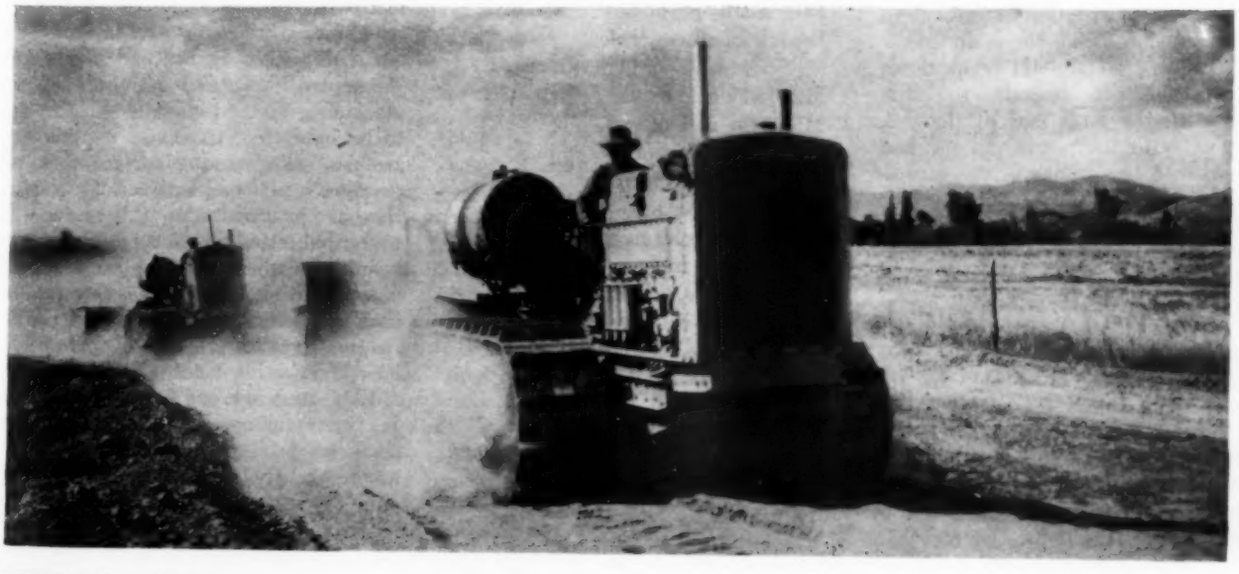
Abstracted from a talk by G. C. Riegel, chief metallurgist, Caterpillar Tractor Company, given before the Tri-City Chapter, American Society for Steel Treating, January 10, 1933.



Careful heat-treatment of selected materials is necessary to prepare the parts for the heavy duty they must withstand

Trail breaking near Randle, Washington, is a severe test of materials and manufacturing methods; as high as 400 yards of dirt have been cast in one hour

On an Idaho state highway, two diesels each move 500 yards of earth in 8 hours



FRED H. COLVIN
Editor, *American Machinist*

Modern Motor Methods

II. Connecting Rods

CONNECTING-ROD manufacturing methods vary considerably in different plants, particularly as to the sequence of operations, the greatest uniformity being in the straightening of rods before machining. A few start with coining, or cold pressing the bosses at both ends, presses of 600 tons or more being used. This not only flattens the surfaces so they will lie flat in fixtures, but makes the metal more dense. One concern flattens to within 0.005 in. of desired thickness. Straightening is still a hand operation. A vise or holding fixture, a wrench for twisting, a soft hammer for bending and a gage for checking, constitute the equipment. Further straightening is done if found necessary, as indicated by the operation numbers. One rod gets three straightenings. Some engineers feel that straightening is undesirable and that stresses are set up which tend to relieve themselves in use, thus throwing the rods out of alignment later. There are, however, millions of rods in use that have been straightened during production and give no trouble in service.

A list follows which has been prepared to show the wide variation in ideas as to the best sequence of all the main operations. Tables I, II and III break down the operation into sections, the first dealing with the large end of the rod, the second with the piston pin end and the third with the drilling of the various oil holes. These tables show a wide variety of practice as to the sequence in which the various operations are performed. Drilling of the large end varies from the fourth to the eleventh operation. Sawing off the caps, which is one of the major operations, varies from being the seventh operation, to the twenty-second, while babbitting varies from the thirteenth to the thirtieth.

The joint face of rod and cap is also treated differently. The face is milled or ground, sometimes both, in order to insure a good seating for the cap, and this whether shims are used or not. A few builders elongate the large hole bored in the rod so as to give a round hole after the cap has been cut off, the elongation being equivalent to thickness of the saw used.

It was formerly quite common practice to rough drill both ends of the rod in one operation. This seems to have given way to drilling each end separately, although several now finish bore both bushings with a fly cutter at the same time and in a special machine. The tools used are either diamonds or tungsten-carbide.

Another difference in operations depends on whether the piston pin bears in the rod or is clamped by a pinch bolt. Where the pin is clamped in the rod the small holes are usually reamed or broached, and slotting, drilling, countersinking and tapping are necessary. When the pin bears in the rod, a bronze bushing is usually pressed into the rod, except that in aluminum alloy rods the pin sometimes bears in the rod itself.

Seats for the bolt beads and nuts are usually milled at the same time the cap is sawed from the rod. Some makers drill and ream the bolt holes before the cap is sawed off, some drill before cutting but ream afterward, while others drill separately, though at times on the same machines.

These holes are usually drilled vertically and frequently with a few spindles. But indexing fixtures on station type machines are the rule so that the rods can be loaded and unloaded while the drills are at work.

When it comes to the bearings on the large end of the rod, there is a distinct difference in practice. Many adhere to the practice of casting the babbitt directly in the rod and cap while some others use a bronze or steel backed bearing shell, seated in the end of the rod. These two practices require different machining methods. Where the rod is to be babbitted, the main requirements are parallelism and a surface that will permit a good bond between the rod and the bearing metal. For this reason rods to be babbitted do not require as fine a finish as where the bore must support a separate shell, as it has been found that the shell must have a solid bearing in the rod, to prevent distortion and lack of effective bearing area.

Babbitted rods are finished by broaching or reaming, while rods to receive steel or bronze-backed bearing shells, are frequently ground to insure parallelism, roundness and a smooth seating surface.

List of General Operations

Cold press, or coin, the end bosses
Straighten rod
Rough drill hole in large end
Rough drill hole in small end
Rough ream hole in small end
Finish ream hole in small end
Face large end bosses
Face small end bosses
Broach small end hole
Mill bolt seats and cut off cap
Mill joint face of rod
Mill joint face of cap
Grind joint face of rod and cap
Drill bolt holes in rod
Drill bolt holes in cap
Ream bolt holes in rod and cap
Bore hole in large end
Ream hole in large end
Inspect hole in large end
Assemble rod and cap
Babbitt rod and cap
Bore and ream babbitt
Finish babbitt bearing
Press in small end bushing, where used
Ream and finish pin bearing hole
Drill oil holes, including gun drill

Method of locating connecting rods in the various fixtures used, vary widely. Perhaps the most common method is to place the small hole over a pin or stud and secure sidewise location from surfaces milled on the sides of the bolt bosses. Some locate the large end by centers in countersink holes, and this method has also been applied to the small end. The aim in all cases is to hold the rod without distortion at each operation and to avoid stresses that will impair alignment. For, though rods can be easily straightened by men who become experts, it is an operation to be avoided if possible.

Drilling Oil Holes

Oil holes through the rod have replaced the small brass or copper tube of earlier days in some rods. But all designers do not consider this necessary and depend on the fog or mist, of oil thrown up by the rapidly revolving crankshaft. These holes vary slightly in size, but are usually close to $\frac{7}{32}$ in. in diameter. Owing to the length required and the small diameter, this is usually a gun-drilling job, using fairly heavy oil pressure to clear the chips out of the hole. Step-by-step drilling is also being tried for this work, and the results so far obtained hold considerable promise.

Grinding does not enter largely into connecting-rod work. Some shops have made it a practice to grind the holes in each end, but diamond boring has replaced this so far as the small end bushing is concerned. The large end is frequently finished in the same way and at the same time. The sides of the bosses at each end are ground in some shops, and a few finish the joint between rod and cap by grinding.

Only the more important operations are given in the table, the others, such as washing, burring holes and joint surfaces, milling the radius on either end of the rod and similar operations are common to several makes of rods. In the same way we find pickling, sandblasting, blowing out the oil holes and other operations, some of which are peculiar to the design of the rod.

Some of the makers, including most of those who use a babbitt-bearing cast into the rod, use selective assembly in fitting the rods to the crankshaft. In one instance the maximum difference is 0.010 in., but the tolerance is held to 0.0005 in. in each case. The piston pins are made for selective assembly in nearly all cases. It is common practice to heat the pistons, especially if they are of aluminum alloy, and also to make the pin a light push fit in the rod bushing.

In a few cases the sides of the rods are polished, the channel also being ground. Some contend that incipient cracks are found in this manner, but the great majority of rods are unfinished except perhaps by sandblasting. One builder at least, cold presses, or coins the complete rod to close limits, which gives a near approximation to a rod finished all over. In most instances, however, the cold pressing is confined to the bosses at each end.

One method of semi-finish is to hollow mill the bosses at each end, which breaks the corners and also helps to secure uniform weight to the complete rod.

Babbitting is done both by die-casting the bearing into the rod and by centrifugal casting or "spinning." The latter is an easy method and has great appeal because of the simplicity of the equipment necessary. The operations of washing, cleaning the surface with acid and tinning are similar in either method. The quantity of excess babbitt to be trimmed is likely to be greater with the die or pressure cast bearings.

Sand blasting and Brinell testing are common in connecting-rod work. A few grind and polish the sides and channels of the rods, but this is unusual in automobile work although common in aviation engine work. Cold forging or coining seems to secure almost the same uniformity. The usual reason given for a fine machine finish in aviation engine work is to aid in the detection of cracks that might lead to failure in service.

TABLE I
Connecting Rod Operations — Big End

Sequence of Operations	Companies A	B	C	D
Flatten or coin	1	..	1	..
Rough drill	4	9	11	4
Rough ream	20	..	11	6
Finish ream	21	..	..	..
Face sides	14	10	11	40
Grind sides	..	..	..	3–42
Chamfer face	7	10	30	7
Mill bolt head seat	13	16	7	22
Saw off caps	13	16	7	22
Mill locating pad	15	8	9	..
Mill joint face	14	17	9	27
Grind joint face	..	..	..	49
Drill bolt holes	16	20	19	28
Ream bolt holes	36	20	19	31
Assemble cap and rod	29	24	12	36
Babbitt — mold or spin	30	13	15	24
Rough bore babbitt	..	15	29	37
Rough ream babbitt	37	28	37	55
Finish bore babbitt	38	37	41	60
Finish sides of babbitt	..	38	49	..

TABLE II
Connecting Rod Operations — Small End

Sequence of Operations	Companies A	B	C	D
Flatten or coin	1	..	1	..
Grind sides of boss	..	..	3–31	3
Rough drill	5	2	4	8
Rough ream	6	6	33	8
Finish ream	..	..	33	47
Broach	10	7	..	..
Face sides and chamfer	8	3	5	9
Hollow mill boss	..	..	..	16
Press in bushing	..	26	40	52
Rough ream bushing	..	27	..	..
Semi-finish ream bushing	..	30	..	..
Burnish bushing	..	..	..	53
Finish bore-diamond	..	34	41	60

TABLE III
Connecting Rods — Oil Holes

	A	B	C	D
Hole in piston pin boss	41	4	22	33
Gun drill through web	..	..	21	34
Hole in large end	42	41	36	46

Spacing Holes in a Circle

Discussion

FRANK A. GABRIEL

Referring to the article by Charles Kugler under the title given above (*AM*—Vol. 76, page 837), I have the following comments to offer:

By the use of sector arms carrying bushings for drilling and reaming holes in a circle, there is still ever present the source of cumulative errors. The chordal distance being predetermined and the sector arms set to it, two holes are drilled and reamed. The sector arms are then rotated to each succeeding position, being located by inserting a plug through the bushing of sector arm *A* and into the nearest finished hole. This method is a case of working from hole to hole, therefore, the chances for cumulative errors are not eliminated.

The last position in the first setting, that is, the chordal distance between holes 1 and 6, may be plus or minus of the desired measurement, being relative to the way in which the sources of cumulative errors have been favored in setting the sector arms. The first six holes drilled should be the key positions. If they are not accurately spaced, any intermediate holes located from them cannot have an accurate, even spacing.

In setting a series of buttons around a given circle, it is seldom that one can start from one button and continue around, measuring with a micrometer to each successive button, and expect to find the last division to be absolutely correct, as there are many factors to be considered that will cause cumulative errors. This is given merely as an illustration.

These comments have been given because of my experience in actually using the method described by Mr. Kugler. The method described by me (*AM*—Vol. 76, page 406) overcomes the objections stated above.

The Alumilite Process

For Decorating and Protecting Aluminum Products

H. BENGSTON AND **R. E. PETTIT**
Chief Engineer *Sales Engineer*
Aluminum Colors Incorporated

THE FIRST requirement of a protective coating is that it be continuous—that it completely encase the article to be protected. In the case of corrosion, the corroding agent can only act on or through the protective coating, and as the protecting material can frequently be selected to meet the specific condition, attack can be reduced to a minimum. Such protective coatings as paint films, oxide coatings, etc., fall in this class.

If the coating is metallic in nature and is not impermeable or does not cover completely, various electrochemical phenomena must be considered, and the corrosion rate will be governed by variables such as the electrolytic solution pressure, by the nature of the corroding agent and by film formation. Such protective coatings as zinc or cadmium on iron, and the aluminum-clad aluminum alloy material trade-marked "Alclad" are examples falling in this class.

The increasing demand for aluminum and its many alloys has directed attention to the art of surface preparation, which in turn has made possible the use of these materials in various industries. Many of the coatings applied to aluminum are for the sake of surface appearance.

The scientific and commercial development of the Alumilite process for anodic coating with sulphuric acid was a long and painstaking problem. The shop procedure involved is, however, fairly simple and requires no technical knowledge, though such is of advantage. Control of operation has been simplified until an operator can quickly be shown the necessary manipulations. General job shop practice is more involved, owing to the greater diversification of the work, than is that of a manufacturing plant where production is confined to a few articles.

In Alumiliting, as in electroplating, the character of the surface treated will largely determine the finish of the resulting oxide coating. If a lustrous, polished surface is desired the base metal must be equally well finished. The lustrous Alumilite coating has a matte opaque grayish surface quite unlike the highly polished natural aluminum surface. When properly executed, the surface smoothness of the base metal is unchanged during electroplating. In the Alumilite process the surface is sometimes etched, and may therefore show more or less of a crystalline structure after oxidizing. The etching effect may be objectionable, especially upon sand castings of certain compositions, because it leaves the surface very rough or pitted. Likewise, defects due to foreign matter in the metal surface, or blow-holes in the castings filled by welding, are thereby exposed. The physical structure of the metal, as produced by the heat treatment or fabricating procedure, also affects the color and character of the finished surface.

Abrasives for Polishing

Sheet metal articles are often treated in the fabricated condition without any polishing operation. When lustrous finishes are desired, the surface can generally be cut down on a stitched cloth wheel using Tripoli as abrasive, and followed by buffing with a lime coloring composition. For the more severe polishing work sometimes required on stampings, forgings, die and permanent mold castings, and sand castings, an oiling operation is used with 200-mesh emery as abrasive. Occasionally even coarser abrasives are necessary, especially on sand castings. The most desirable preparation for sand castings, when permitted, is sand blasting.

Only aluminum or certain of its alloys can be used in rack construction. Because of electrolytic solution of other metals when made anode, and also because of the high electrical conductivity of the bath, the rack must insulate itself anodically or show some passivity. Racks of copper or brass construction would allow passage of current to the rack rather than to the aluminum articles carried, because of the resistance imparted to the surface of the latter by the formation of the initial oxide coating.

The currents carried are not large as compared to chromium plating requirements, yet contacts must be as firm; otherwise an aluminum oxide coating may form between contacts and disrupt the flow. Contact points must be renewed after each load by stripping in dilute caustic solution to remove the otherwise insulating coating.

Cleaning is not as serious a problem as in electro-plating, for since the process is anodic, it has considerable inherent cleaning action. Preferably, cleaning is done after racking. Heavy layers of grease are removed by an organic solvent. Mild cathodic cleaning may be used. A dip in hot caustic solution removes thin films of oil or rolling films from the surface of the metal. This alone is used where very light oil has been used in fabrication. Where commercial cleaners are used, they must be free from sodium silicate, often used as an inhibitor in aluminum cleaners.

After rinsing, the aluminum is immersed as anode in the Alumilite bath, the lead tank lining being the cathode. Generally, contact with the work-rod closes the electrical circuit. The bath composition is varied, depending upon the character of the coating desired. The operating voltage generally lies between 12 and 15 volts. At this pressure the current density will average between 12 and 14 amp. per sq.ft. for the

Alumilite "A" bath, and 8 to 10 amp. per sq.ft. for the Alumilite "B" bath. Temperature, too, is pre-determined, usually in the range of 70 to 90 deg. F. Time of treatment is determined by coating thickness desired. After the anodic treatment, the work is immediately and thoroughly rinsed to remove any retained electrolyte.

Chemically, there is little difference between the "A" and "B" coatings. Physically, there is much difference. The physical difference between the two types of coatings is produced basically through the operating temperatures and concentration of the bath and the organic and inorganic inhibitors or modifiers used.

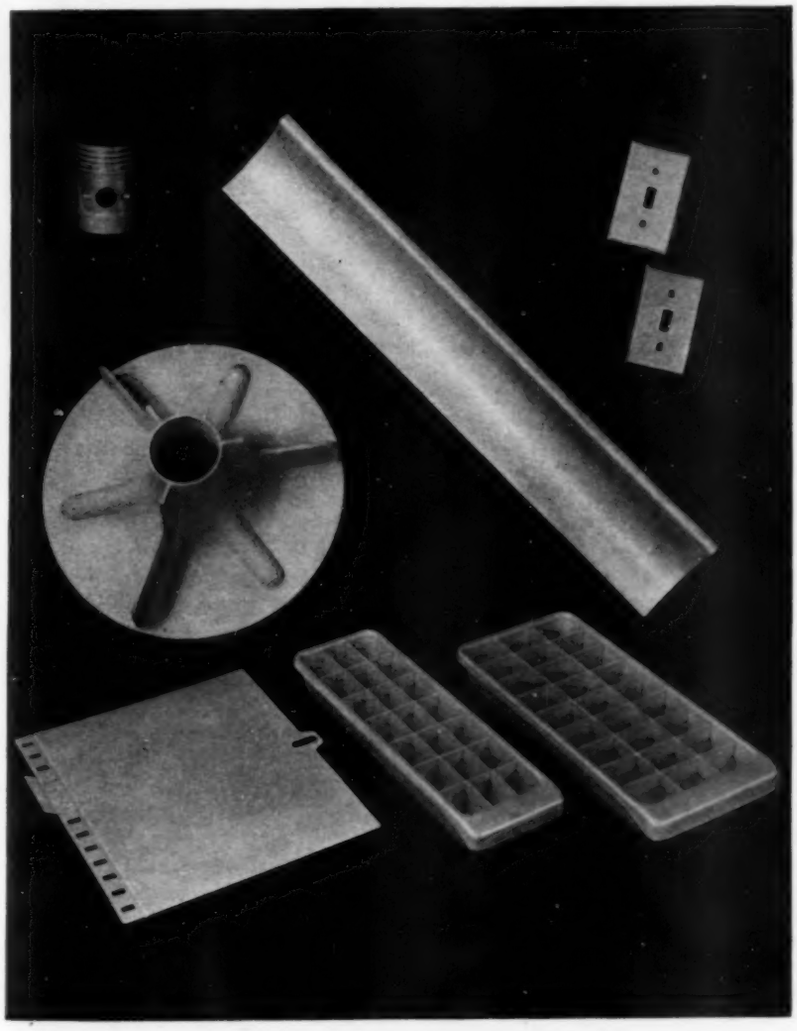
Each type of coating has its particular field. The "A" coating is used where corrosion and abrasion resistance is paramount. Because of the extreme hardness of the "A" coating, it does not lend itself for fabricating purposes.

The "B" coating, because of its flexibility, makes an excellent surface preparation for sheet material that is to be subjected to mild forming operations, the "B" coating following the formations without visible damage. However, to obtain the advantages of the flexible coating, a portion of the abrasion, corrosion and electrical resisting properties exhibited by the "A" coating are sacrificed. Both types of coating are equally well suited for color purposes.

The procedure thereafter may vary considerably. The articles treated may be left in the plain oxidized condition, or they may be colored with organic or inorganic colors, oiled, sealed, waxed, lacquered, etc.

The coloring of Alumilite coatings consists briefly of immersion, after anodic treatment, in dye baths made from carefully selected aniline dyes. They may also be colored by a special procedure involving the deposition of inorganic pigments within the pores of the coating. The latter colors are commercially sunfast, the former are not. Dye-baths are of semi-permanent types, as contrasted with the one-batch bath used in textile work. Fresh dye is added to maintain a definite concentration.

One of the most important developments of the Alumilite process is the sealing treatment. This treatment effectively closes the pores of the coating, preventing any further adsorption. Colored and uncolored coatings may be so treated. The coating is thereafter resistant to oil, food stains or other materials and finger marking is thereby prevented.



Articles finished with a plain Alumilite coating to prevent staining, smudging, abrasion and surface disintegration

Types of Tanks

Although most of the Alumilite work is done at the present time in still tanks mechanical processes are possible. One full-automatic unit for handling a multiplicity of small parts is under construction at the present time, and others are contemplated. There is in operation at our plant a 75-ft. unit for automatically processing coiled stock in 700-ft. lengths, one or more sheets at a time, depending upon width. Material is finished with or without color, oil or lacquer. Material so finished is used for fabrication. To make working of the metal practicable, it is desirable to anodize in the "B" bath, whose composition is adapted to produce a soft film. Still another piece of equipment is being developed to process small articles such as screws.

From the technical and theoretical point of view, the Alumilite coating is primarily an oxide coating, Al_2O_3. It is more or less hydrated and contains more or less sulphate. It is formed in a solution containing sulphuric acid and water, together with various addition agents. The properties of the coating are largely determined by the acid concentration, and the temperature of the electrolyte and the addition agents. Whatever the mechanics of formation of the coating, from the practical point of view, the process consists of electro-chemical oxidation. The actual procedure is probably very complex and involves little-understood colloidal phenomena.

Heat measurements show that the heat liberated is in excess of the amount which could possibly result from the power consumption. The bath itself has a very low resistance in all operating compositions; the greatest resistance in the circuit is at the coating itself. Some of the liberated heat is undoubtedly the heat incident to the formation of aluminum oxide.

Growth of coating is a race between coating formation and its solution in the electrolyte, which means that there is a limit to the thickness of coating that can be formed—that after a period of time the rate of formation of the coating is balanced by its rate of solution.

As has been indicated, the Alumilite process utilizes only certain concentra-

tions of sulphuric acid. Under normal operating conditions only certain ranges of concentration are adaptable. With compositions, however, where etching or chemical attack is severe, inhibitors may be used to modify the action of the acid.

The Alumilite coating, properly applied, exhibits remarkable resistance to salt spray and atmospheric and chemical corrosion. The application of the oxide coating to aluminum is a case of making a good corrosion-resisting surface very much better. Much depends upon the condition of the metal, which determines the quality of coating obtained, other conditions of formation being correct.

2S and 3S aluminum of good quality produce the best coatings. Silicon in alloys does not appear to decrease the corrosion-resistance of the film, and its alloys, such as No. 43, which is largely used for architectural castings, are therefore well protected by the Alumilite coating. The density of the alloy, and freedom from pits, blow-holes and segregation, are also important factors in corrosion-resistance.

For service in direct contact with many of the common chemicals, aluminum is an old standby with the chemist and engineer. While complete information is not yet available on the chemical corrosion-resisting properties of the Alumilite coating, such substances as alkalies and mineral acids attack the film with varying degrees of rapidity. Salts which hydrolize, giving rise to acid or basic solutions, may show some attack upon the coating, while neutral salt solutions do not attack it. In general, the aluminum oxide coating exhibits resistance to the same chemicals, though to much greater degree than the natural aluminum surface.

Sealing the Surface

Through research work a method of quick sealing of the coating has been developed. The coating so sealed is many times more resistant to corrosion than that which is freshly formed. Added resistance to chemical attack can be obtained by impregnating the coating with various comparatively inert compounds, such as oils, waxes, and other materials, which are tightly held within the capillaries of the coating and efficiently inhibit common types of corrosion. Conditions surrounding the use of specific chemicals often govern the possibility of using oxide-coated aluminum equipment. Those who contemplate the use of oxide-coated aluminum will always find it to their advantage to consult with persons versed in the art of oxide coating, for the technical advice and service they are glad to furnish.

Articles processed with the colored Alumilite coating for decoration and for resistance to abrasion and corrosion

Householders have found that aluminum stains occasionally in contact with certain foods, drinks and other materials. The use of a sealed Alumilite coating prevents such staining. This is another reason for its use upon refrigerator trays, cooking utensils, etc. The finish has proven very advantageous in the case of cafeteria trays.

Closely related to the non-staining feature is its non-smudging property. Aluminum abrades when rubbed against other materials. This effect is known as smudging. Utensils leave marks on kitchen sinks. Cafeteria trays leave a smudge upon run-ways in restaurants, and if the hand is rubbed against these run-ways it becomes blackened with finely divided aluminum. Alumilited cafeteria trays do not smudge, and excellent service has resulted from their use. All aluminum articles subject to much handling are well served by an Alumilite application. Handrails on buses, street-cars and railway cars are applications in point.

One very interesting property of the Alumilite coating in all its applications is its hardness and therefore abrasion resistance. It is much harder than any other metal finish. This is understood when we consider that alumina has a hardness of 9 on Moh's scale.

The fact that the coating may be colored, oiled, etc., after its formation indicates that it is absorptive, or of a microscopically porous nature. When lacquers or varnishes are applied to the coating in thin layers, they are firmly bound to the surface. The fact that the coating is integrally united with the aluminum surface, coupled with this phenomenon of absorption, explains why such coatings are excellent bonds for paints and similar finishes. Expensive sand-blasting procedures and primer coats can usually be eliminated by the use of Alumilite coatings. For this reason it is expected to find applications in the finishing process used upon aluminum furniture.

We have indicated above that the coating formed in the "B" electrolyte permits forming without chipping or scaling. Such deformation will produce microscopic fissures in the coating, but does not impair its appearance. The coating is so integrally attached to the base metal that though stretched beyond its elastic limit it still adheres firmly to the aluminum. If, however, the deformation is too great, the coating will be so widely distributed that the base metal is exposed. This is evident particularly with colored coatings.

The physical properties of the metal are important with respect to the workability of the coating. We have found 3S alloy in the annealed temper to be adapted to such purposes. The metal thickness selected sometimes has an important bearing upon the suitability of the treated metal for particular draws. A few products formed at the present time are: marking tags, chicken leg bands, embossed name plates, buttons (including two-metal buttons), refrigerator box trim and window channel for automobiles.

From the standpoint of the color effect alone, the finish is quite pleasing, having a metallic background showing through the colored surface with an effect like that of cloisonné. The colored oxide coating is exceptionally hard and resistant to abrasive action.

Sufficient data are not available at this time, either from actual service ex-

perience or accelerated Fade-Ometer tests to determine the exact serviceability of the dyed coating when used for service out-of-doors. It is well known that all organic dyes are prone to fade in some degree when exposed to sunlight. There are a number of dyes that show remarkable resistance to fading, and these dyes may find application for limited outdoor service. All the commercial dyes now used in connection with the colored oxide coating are practically permanent for interior service.

Four colored coatings of an inorganic or metallic base that are commercially light-fast have been developed—black, blue, yellow and brown—and it is hoped that extensive research work now being conducted will soon develop additional light-fast colors. In addition to the plain surface, there are unlimited possibilities offered through two-color effects —engraved, stippled and mottled.

The selection of the proper aluminum alloy for color work is necessary if the true color tones are to be portrayed in the finished article. Certain metals, notably silicon, which is alloyed with aluminum to improve the physical properties, modify the color of the anodic film. The darker colors, gray to black, which are produced on these alloys, materially interfere with the dyeing of the coating. Advantage is taken of the dark coating brought about by a high silicon content in an aluminum coating. By proper treatment, it is possible to produce an oxide coating on aluminum castings of the silicon-alloy group, that ranges from a light gray to black.

The anodic coating has a melting-point far in excess of the melting-point of aluminum, and is therefore heat-resistant. The incorporation of a black color in the anodic coating greatly increases heat absorption from radiation. Experimental work has shown an appreciable decrease in the time required to boil a given quantity of water by the use of a utensil with a black anodic coating on the bottom, as compared with a natural aluminum surface.

Bright aluminum has a very low emissivity or heat-radiating power. This is sometimes disadvantageous, but by application of an Alumilite coating, plain or colored, the emissivity can be greatly increased.

The dielectric constant of the oxide coating is about 8, for a coating thickness of the order of 0.002 in. If mechanical properties are unimportant and the coating thickness is built up, the dielectric strength or breakdown voltage can be enormously increased.

The specific resistance of the film, which is about 1.5×10^{10} ohm/cm., decreases rapidly with rise of temperature, and decreases with increasing humidity.

• NEW BOOKS •

MANUFACTURING MARKET STATISTICS. *Prepared by Charles B. Eliot, Domestic Regional Division, Bureau of Foreign and Domestic Commerce, Department of Commerce, under the direction of E. F. Gerish, chief of that division, and with the special cooperation of the Bureau of the Census. 1,070 pages, 6x9 in., largely tables, but containing several maps. Copies obtainable from Government Printing Office, Washington, D. C., or from district offices of the Bureau of Foreign and Domestic Commerce.* Price $1.

This volume is a compilation of basic marketing data designed to aid sellers of products consumed in the manufacturing industries to locate their markets more accurately and economically. A prominent feature is the plant-location section showing for the first time on the basis of the 1929 Census of Manufactures the location by state and county of more than 200,000 manufacturing plants representing a market for $36,000,000,000 worth of materials, classed in 326 primary industry groups. Examples of use of the reports data in problems of practical market analysis are included.

In the field of industrial marketing relatively little research has been done, largely due to the scarcity of basic statistical data. As a step to supply this lack, the new marketing guide was undertaken by the Department of Commerce at the request of a number of industrial marketing groups, the work being carried out under the direction of a national committee composed of executives in the advertising and manufacturing fields.

The market indicators tabulated include number of plants, workers, wages and salaries, horsepower of equipment, material cost and value of output, by states, by cities of 10,000 population and over, and by major industrial areas.

WHAT IS TECHNOCRACY? *By Allen Raymond. 180 pages, 5x7½ inches. Published by Whittlesey House, McGraw-Hill Book Co., Inc., New York. Price $1.50.*

In his effort to explain technocracy and the individuals back of it, Mr. Raymond draws on the information gained during his interviews with Messrs. Scott, Jones, Ackerman and Rautenstrauch, and which he used as the basis for four articles in the New York Herald Tribune. He also quotes from books by Thorstein Veblen and Frederick Soddy along the same lines as the technocratic preachings.

To give the arguments against the theories advanced by the technocrats he quotes Dean Kimball, John VanDeventer and President Compton of M.I.T. For those who are sufficiently interested in Technocracy to want to try to find out what it is all about this book should be helpful, because it quotes sources and ties them together in a breezy, newspaper fashion that makes easy reading.

MAN AND METALS. *A history of mining in relation to the development of civilization. By T. A. Rickard. 2 volumes, 1068 pages, 6x9 in. Illustrated. Published by Whittlesey House, McGraw-Hill Book Company, Inc. New York. Price $10.*

In times like these when each one of us is baffled by his immediate problems and environment, and when the future seems all too dark, Mr. Rickard's book comes as a welcome means of restoring one's perspective. Inspired by Wells' Outline of History, partly because he thinks Wells paid insufficient attention to the part played by the miner in man's development, Mr. Rickard has set out to fill this gap. His many years of experience in technical journalism, as editor of *Engineering and Mining Journal, Mining and Scientific Press,* and *The Mining Magazine,* it is very evident, have stood him in good stead in this present work. These two volumes are not only well done from the technical point of view; they are also very entertaining reading.

Mr. Rickard makes it clear that the powerful nations in history have been those that developed or controlled mineral resources. He tells how the Athenians used the silver from their mines to finance the building of the ships with which they repelled the Persians; and how the gold of California enabled the North to wear down the poorly financed South in our own Civil War. And he makes it plain that the United States of America boasts the most lavish endowment of mineral resources ever known, ample insurance of its future growth and power in the world, which should certainly be comforting to our present doubts.

And his account of the struggle of the miner up from the most abject slavery of classic times to a position of unique freedom is a thrilling epic. All in all, Man and Metals is well worth the time it takes to read it. It should prove inspiring to every man who has a part to play in the modern metal industry.

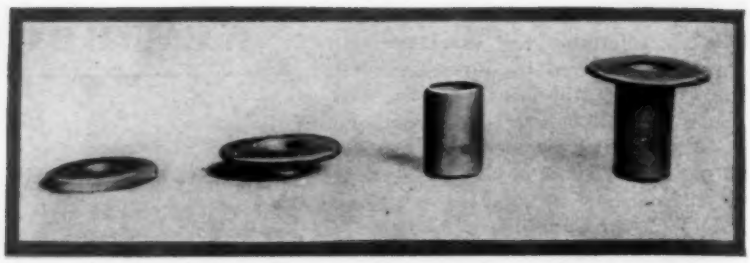


Fig. 1—Formerly made on a screw machine, the valve spring collar is now stamped out in a press and spot welded to the sleeve

Economies

In the Manufacture of Valve Spring Collars

As told to Francis A. Westbrook

By GEORGE KERR

Spot welding proved a saving for both product and tools

RECENTLY the cost of valve spring collars was reduced 50 per cent by a redesign which permitted the use of spot welding. The change is of interest because of the possibility of adapting the same procedure to other parts. Welding also played an important part in making efficient tools for this work.

At the extreme right of Fig. 1 is shown the assembled guard and collar; at the left of this is the guard and next to it is the collar with a shoulder provided for spot welding. Originally the collar was made by screw machine in the form shown at the extreme left. The cost for labor, material and overhead was formerly 6 cents; acetylene welding cost 16 cents. By changing to press tools and employing spot welding, the cost of material, labor and overhead was reduced to 2.7 cents and the welding to 7.5 cents. This made a reduction of from 22 cents to 10.2 cents or about 54 per cent in the total cost.

Under the new plan of manufacture, a progressive die, shown in Fig. 2, is used to make the blanks which must be accurate and have outside and inside diameters of odd sizes. It will be noted from the illustration that bosses have been arc welded to a steel base to form the pillar posts. The rate of production is 2,000 per hour.

The blanks are heated in a rotary furnace; one man loads the furnace while the press operator removes the heated blanks. The furnace travels at the rate of 550 heated pieces per hour. This operation is shown in Fig. 3. The table is cast iron and the head stainless steel. The heated blanks next go to the hot press.

The hot press, in which the collar shown in Fig. 1 is formed, is shown in Fig. 4. Sufficient stock must be provided to permit of reaming the hole when the guard and collar are assembled. In order to strip the formed collar from the die, a groove is cut in the high-speed steel punch. This lifts the collar from the die, and a positive knock-out in the upper section strips it from the punch and deposits it in a cup. This cup is so arranged that it swings backward as the ram of the press descends to form the next piece. The blanked collar then falls out and into a chute through which it slides into a tote box. The collars are then taken to a pickling bath for the removal of scale.

At this point it should be noted that the die holders are made by welding and that high-speed steel and hot-work steel are used for the dies. The production at this point is 500 pieces per hour.

The guards and collars are put together on a table. The assembly is then placed in the welding machine shown in Fig. 5. It will be seen that one of the supports on the anvil of this machine is tapered and has grooves cut in it. This is pressed firmly into the guard while the collar fits in the other support. The collar is then welded to the guard at four points. Approximately

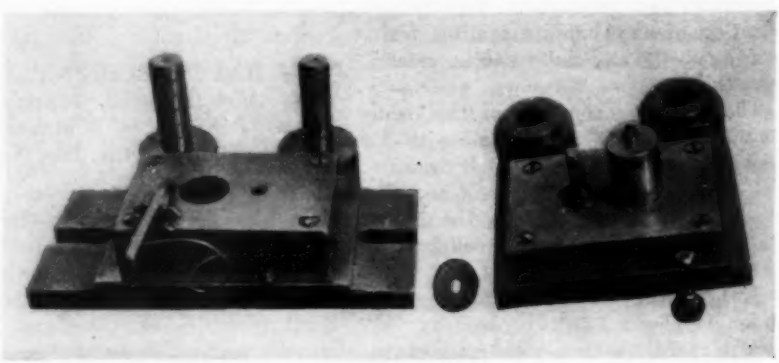


Fig. 2—A welded punch and die served to speed production

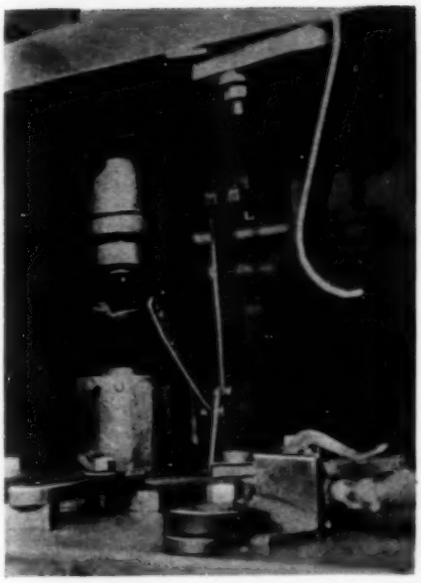


Fig. 4—Welded punch and die holders are used on this hot press for forming the collars

even spacing of the welds is secured by having four flat places on the grooved support which come in contact with a wire spring. As the operator turns the knurled handle, seen at the right, he can feel easily enough when the flat spots come against the spring and thus know that the welding point has been reached. In arranging the welding machine for this work, the copper fixture was welded to the copper arm of the machine. Production is 400 per hour.

After this operation, the work is annealed in order to remove the hard spots caused by spot welding. Another pickling is then necessary in order to remove the scale resulting from annealing.

The final operation consists of reaming the collar. This is shown in Fig. 6. The work is held in the jaws of a foot-operated vise. The reamer, which is floating, has a steep spiral and is flooded with oil, a dial indicator being used to show the depth of the cut. This reamer will do from one to four thousand per grind.

The press shown in Fig. 6 was made from a three-spindle machine and an arc welded table. The piece shown clamped to the press is for pushing out the chips. Production is 400 per hour.

From the foregoing description it will be seen that not only has the cost of the finished product been cut in half with the help of welding but also that, by means of welded construction of the tools to do the work, it has been possible to adopt standard tools or tools made of standard parts with a maximum of economy. In fact we use welded construction on our tools wherever possible as this method saves time and material.

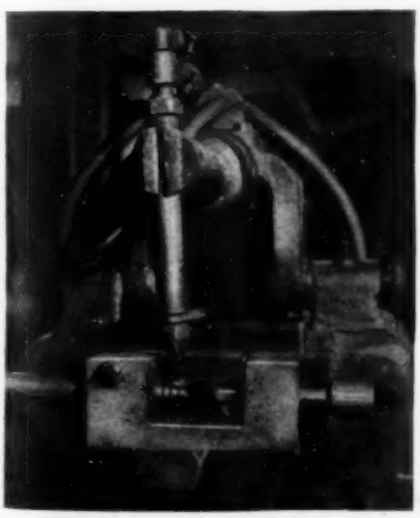


Fig. 5—Collar and guard are spot welded together at four points

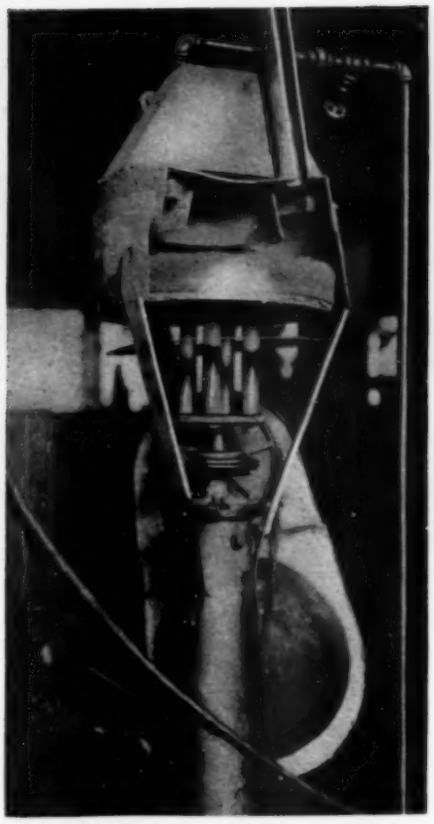


Fig. 3—Blanks at the rate of 550 per hour are heated in a rotary furnace

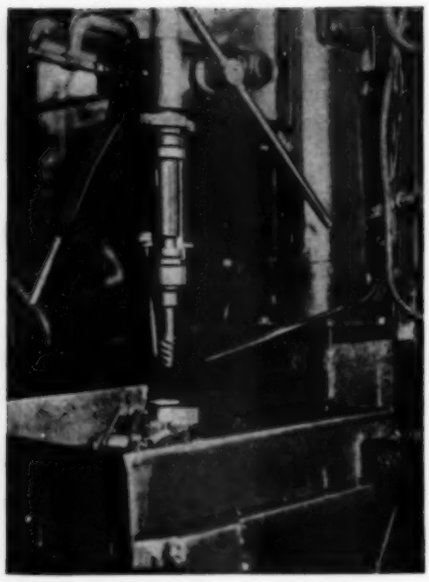


Fig. 6—Clamped in a foot-operated vise, the work is reamed in an improvised drill press

Cut and Dried Shop Data

Multiplication tables, the weight of metals or abstract measurements can be readily tabulated and used without hesitation in planning and in calculation. But the great majority of shop problems are not as yet susceptible to such routine or standardized treatment.

Men frequently ask for tables of speeds and feeds for all metals and other materials, or diagrams and charts that will show whether a job should be put on a 26-in. lathe or a boring mill. One wants a chart that will tell him the capacity of all types of machine tools so that he can select the right machine for any job that comes along. Those who request information of this kind do not realize to what extent many of the questions asked depend on conditions that cannot be satisfactorily tabulated.

The kind of work to be machined has a direct bearing on the machine to be used, on the tools and on the speeds and feeds. A 15-inch light pulley or drum might be turned on a 16-inch lathe, while a 15-inch steel billet would probably go in a 26- or 30-inch lathe. The tools, speeds and feeds would all be different for the two jobs. While suggestions can be made that apply to both cases, judgment, based on experience or observation, must determine the best procedure for each case.

Even in cases where the same operations have been performed many times, and where standard practices have been adopted, the man on the job frequently discovers a better method. He may change the shape of the tool, accidentally or otherwise, or set it differently, or get mixed on his speeds and feeds, and the result may be a better job or lowered machining time, or both.

We should by all means utilize our accumulated and tabulated knowledge as far as possible. But it is usually better to use it as a starting point toward better practice instead of assuming it to be the last word in efficiency.

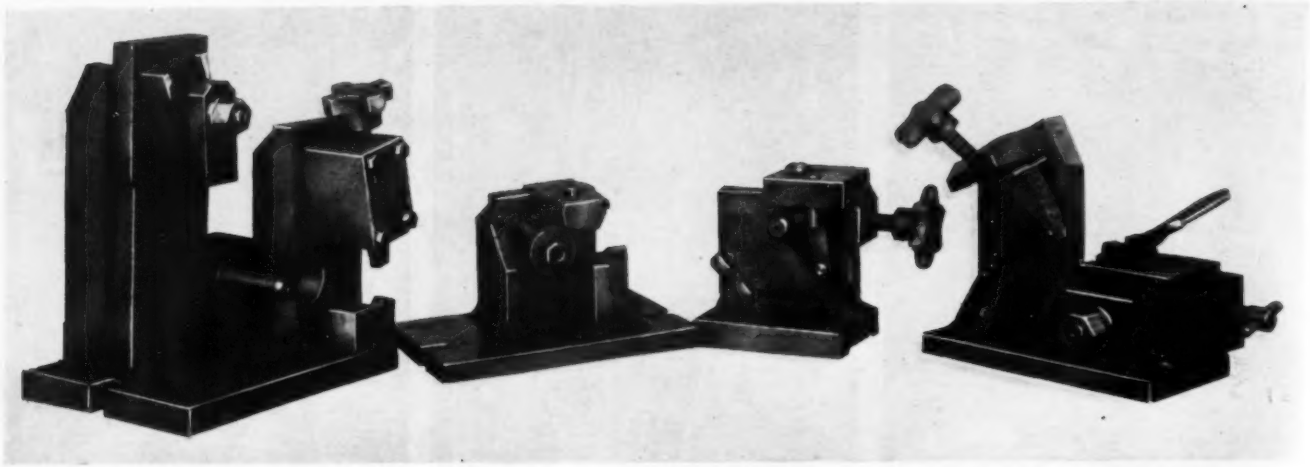


Fig. 1—Economies in time and cost are gained through the fabrication of clamping fixtures by welding

Low-Cost Tooling

J. E. PADGETT
Assistant General Manager
Spicer Manufacturing Corporation

Simpler, more flexible machines and fixtures with extensive use of welded construction are recommended for automotive operations

INCREASING demand for changes in automotive products and the substitution of new devices will become evident within the next few years. Managements are concerned about (a) loss of sales if changes are not made; (b) excessive cost of tooling if changes are made, which cost may offset temporarily all of the gain in sales; (c) resistance of the shop organization to any change; and (d) the difficulty of persuading the designing engineer to consider properly the problems of manufacture. Since such changes are coming in all successful companies, manufacturing divisions must be ready to carry them through. I will outline some principles regarding the adaptation of equipment to meet these changes.

After direct-labor costs, the next largest items of expense in a machine shop are generally depreciation and obsolescence of machines, fixtures and tools. This is especially true when changes are taking place rapidly and even more so when a plant is tooled for high production. The only way to reduce these charges is to make the machines last longer and thereby reduce the rapidity of obsolescence. We must at the same time keep up with the latest production methods. The economics of the situation always govern in the end, and if new machine tools are needed or if new developments of great value are made, these machine tools will be purchased. If they are not needed, no amount of selling will cause purchasers to act.

I believe that the machine tool industry could accomplish much if it would arrange to reduce its prices and that this can be done; but the industry will be obliged to get away from its present cast-iron type of designing and many of the present manufacturing methods. A few machine tool builders have already done a good job of this kind, but this practice certainly is not general. Meanwhile, we in the manufacturing end should not demand unnecessary work or weight for the sake of appearance, and in this way the machine tool builder can save cost. Further, the machine builder should be in the best position to make proper fixtures for use on his machines, but to get most of them to do a good job in this type of work seems impossible.

In a general consideration of machine-shop practice, we must decide on the correct place for simple single-spindle or single-operation types of equipment as compared with multi-spindle multiple-operation machines. My experience is that the high-production multiple-tool machine seldom saves anything. Many cases can be mentioned where such machines are a positive saving; but in thousands of other cases they have been found to be source of great expense and trouble, especially when a change must be made and the cost of retooling be-

Abstracted from a paper presented at the annual meeting of the Society of Automotive Engineers, January 26, 1933.

comes excessive. To be economical these machines must be capable of running on a given job over a relatively long period, but seldom, in these days, does any product remain fixed in its design long enough to amortize the tooling. In addition, there is the larger percentage of down time, set-up time and various delays when any single unit gives trouble and stops the entire group of operations.

Highly special high-production multiple-operation equipment is like the investment type of banking, making large profits in boom times but becoming badly frozen and highly expensive in times of low production or rapid change. Simple machinery seems to be a little more costly during boom times; but, when adverse conditions come about, this equipment is good for almost anything and in any quantities, can be changed rapidly and at low cost and over a long period is the safest and most profitable to use.

This discussion will be confined to the problem of tooling, and especially to fixtures of three kinds: first, fixtures that hold pieces while the piece is acted on by some self-contained machine; second, fixtures that not only hold the piece but are depended upon to give accuracy to the operation; third, fixtures that are really complete mechanisms in themselves. Typical fixtures are shown.

Fig. 1 shows a group of miscellaneous clamping-type fixtures. All are made up of pieces of scrap steel cut apart with an oxygen torch and welded together. These are built up from crude drawings and are low in cost, especially if they are not duplicated many times. Steel is 2½ times as rigid as cast iron and also is almost unbreakable in handling. If changes are desired, an acetylene torch and an arc-welding outfit are all that are necessary to cut them apart and rebuild them or to add new locating points or new clamps. This makes them extremely flexible and generally much lower in cost than the usual type of fixture made from patterns and castings. Another advantage is that they can be produced in an hour or two, whereas a casting always takes several days. Many times this advantage is highly useful in getting jobs done on time.

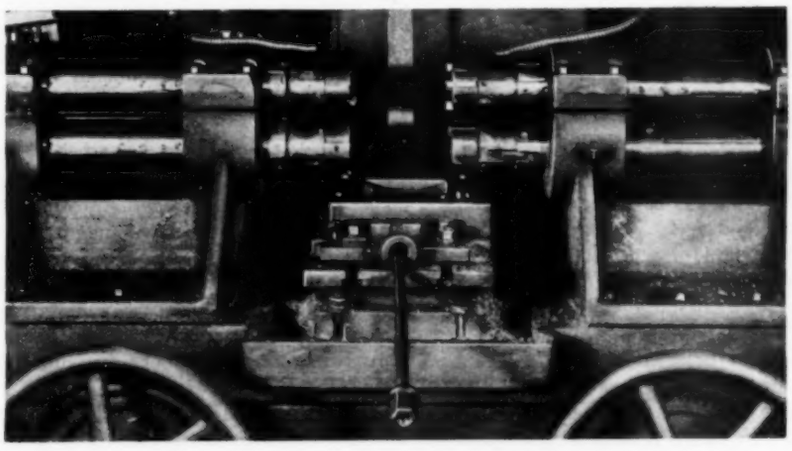


Fig. 2—Transmission case mainshaft and countershaft bearings were formerly bored in the double-end fixture illustrated

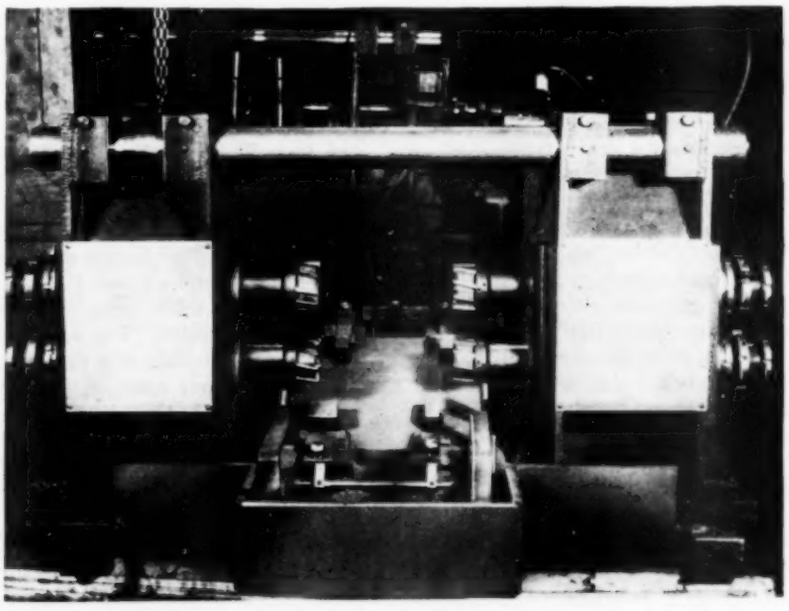


Fig. 3—This fixture now used on the operations shown in Fig. 2 takes care of alignment and can be changed to accommodate new center distances

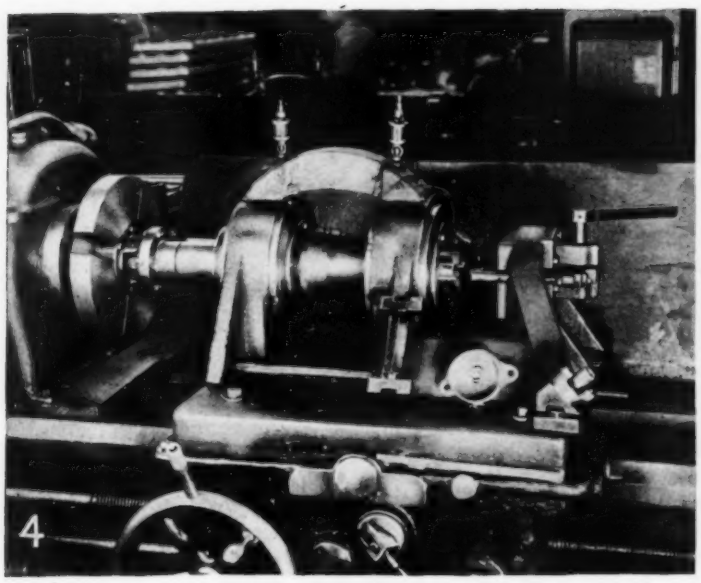
Accuracy Built In

Fig. 2, the second type of fixture, which has to do with accuracy as well as holding the piece, shows a former method of boring the main-shaft and counter shaft-bearing bores in transmission cases. This is a typical double-end machine having fixed centers and bars with wear strips. The machine takes care of the accuracy of work, but the accuracy is not good because the machine tends to spring, wear occurs in its different parts, and the floor may settle at some time. Such things are constantly happening to disturb the accuracy of the work.

The type of fixture in Fig. 3 now replaces that shown in Fig. 2. In this case, the entire operation is self-contained in the fixture. Each spindle is constructed so that it will slide inside of a quill, but a long feather key keeps the spindle from rotating relative to the quill. The quill is mounted in precision anti-friction bearings and then this whole spindle unit is mounted in the fixture. The fixture is built of welded-steel sections and is completely tied together so that, when the piece is put in, the accuracy can be reproduced for many months without any change execpt to regrind and replace cutters.

The spindle itself is fastened to one side of a universal joint, and the other side of the joint is attached to the machine spindle. In this instance the entire set-up has four joints, made with clearance across the shoulders of the central cross so that they can take care of misalignment. Therefore the fixture itself cares for all questions of accuracy and the machine becomes merely a driver and feed mechanism.

This construction results in a fixture costing perhaps one-fith of the machine cost and gives a better job than the original or a new machine. Further, if at some later date a change in the center distances becomes necessary, these spindle assemblies can be taken out, the fixture cut apart with the torch, some plates welded in, the fixture rebored on the new centers, a short propeller-shaft installed in place of single joints, and a new fixture obtained at a fraction of the cost of the original fixture or a new one that we would have to make if this were



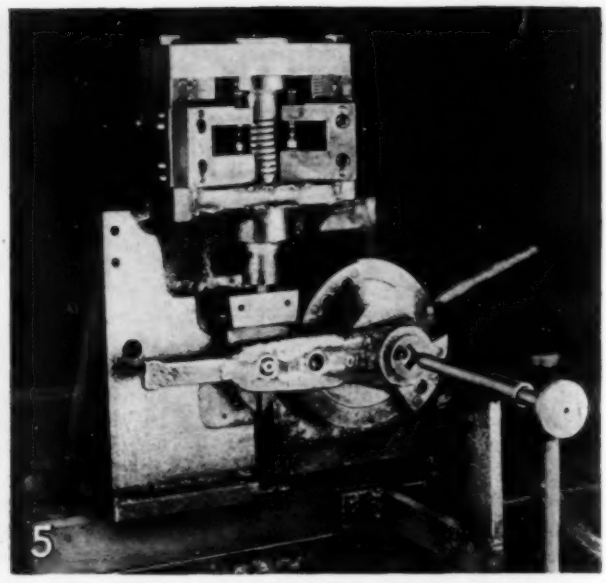


Fig. 4—Several million shock absorbers were held to a limit of 0.0005 in. on this anti-friction bearing type of fixture
Fig. 5—Development on this testing apparatus was expedited by the application of welded construction

not of welded-steel construction. This type of construction allows us to use machinery as long as it will turn over.

Fig. 4 shows another self-contained fixture with anti-friction bearings for finishing the inside of the reservoir of a vane-type shock-absorber. This operation was carried on for about a year, using fixtures lined up as well as possible with the machine spindles and with every care taken in material and up-keep of wear strips and bushings and with maximum precision-grinding on the counterbores. In spite of this, on a total of eight machines we kept two toolmakers continuously busy in maintaining the accuracy of the machines, and the set-up was excessive because only one out of ten cutters would cut to size because of the combination of clearances and errors.

After we installed the present anti-friction-bearing self-contained fixture with universal-joint drive, no machine had to be repaired at any time because of trouble with accuracy in a period of three years, during which several million shocks absorbers were made. Now, after grinding, every cutter cuts to size; whereas, formerly, only ten per cent cut accurately. One can realize the accuracy of this operation in that the piece has three concentric diameters that must be held to a 0.0005-in. limit in one instance and to a 0.001-in. limit in two other instances. The depth from the counterbored seat to the bottom must be held to a 0.0005-in. limit, the bottom must be absolutely square with the cylindrical portion and perfectly flat, no tool marks must show on either side or bottom and the corner, where the surfaces meet, must be square.

Fig. 5 shows a self-contained mechanism. This is a fixture for testing shock absorbers for resistance at car-operating speeds. In this instance we learned very strikingly the usefulness of the welded construction. The operation is to oscillate the shock-absorber at about 100 strokes per min. and to indicate that the resistance is between specified limits. This is shown by checking the amount of movement of a calibrated spring and recording this by having it light a green lamp for "satisfactory" and a red lamp for "unsatisfactory."

We first built this in one design that developed trouble because of friction in various parts of the mechanism. The friction caused a change in the registered resistance on the spring, and the fixture had to be so sensitive that this friction made the whole operation useless. In efforts to eliminate this friction, we changed and rebuilt parts of this machine about a dozen times. We also had trouble with the electrical contacts, which had to be accurate within 0.001 in., and this part of the mechanism also was rebuilt about a dozen times.

Welding Speeds Development

We had only about ten days in which to attain high production. During these various changes and testing, we worked toolmakers constantly day and night trying one thing after another until the machine was worked out so that it was satisfactory as we made each change. Because it is of steel construction, we were able to cut off parts that were wrong, machine the piece, weld on some new piece and developed it for the next trial so that it would be ready to try out within say three hours. If this had been of the ordinary construction, requiring patterns and castings, to go through with the amount of development work would have taken us three months, and we would have been sadly out of the running in getting into production.

We have again changed the design of the shock absorber, and the testing machine has been rebuilt once more to take care of the new product. Most of the old parts were used even though the new design of shock absorber is entirely different. This would have been impossible with ordinary fixtures made of cast iron. This change was made without using drawings; the toolroom supervisor simply was told what was wanted and this was carried out.

A condition exists of which I have heard several engineers talk in no uncertain terms. It relates to the question of what they have to do when trying to crowd a certain number of cubic inches of displacement into an engine having given center distances for the cylinders when the plant equipment cannot be changed to a different set of center distances.

My thought would be to make self-contained fixtures for the individual cylinder bores, tie these together into the correct distances between centers, raise the present fixed-head boring equipment by a riser block and connect the present spindles with propeller-shafts to the new self-contained spindles. For a cost only slightly more than that of a new fixture, one could thus have newly changed boring equipment. Further, if any changes were desired later, they would require only new spacer bars for the individual fixtures. If other fixtures in the cylinder-block line took their locations from the cylinder bores and if these fixtures were made from steel, it would be a simple matter to cut out the old locating points, weld in new parts and remachine to fit any necessary changed condition.

EDITORIALS

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K. H. CONDIT F. H. COLVIN
EDITORS

Equipment Costs

On another page of this number appears an abstract of J. E. Padgett's paper, presented last week at the S.A.E. annual meeting. Most of the points that Mr. Padgett raises are well taken, especially those in regard to the need for simpler and more flexible machine tools.

But in blaming machine tool manufacturers for excessive equipment costs, the paper places the onus on the wrong shoulders. Today, with lowered production schedules and the demand for lower-priced cars, the automotive manufacturer is properly weighing savings in tools against savings in direct labor. A few years ago he was willing to pay for a machine that shaved a few seconds from a given operation without much thought to the next model.

Certain plants became overburdened with special-purpose tools during the years of high production. Some of this equipment is, no doubt, embarrassing to automotive designers and production executives. But, in most instances, it is what they demanded at the time of purchase. The machine tool builder cannot logically be indicted for changed conditions that create new needs.

Mr. Padgett gives a number of examples of home-made fixtures of welded construction and indicates that the same practice should be more widely used. There is no quarrel with the examples shown since special jigs and fixtures offer a particularly fertile field for fabricated welded construction. Undoubtedly weldings will continue to find favor, but their use does not decrease the importance of sound engineering and inventive genius. If the automotive industry is to maintain the standards of workmanship now commonly accepted, it will find that there is more to the creation of a satisfactory production unit than the mere welding together of a few shapes and plates.

Machine tool builders have received less than their share of credit for the development of the automotive industry. Their resourcefulness and ingenuity in supplying the means for quantity production has never been adequately rewarded. As the industry gained in momentum, many of the developments resulted from the combined efforts of automotive and plant equipment manufacturers. There is no reason to believe that they cannot together meet the new problems created by altered circumstances.

Mr. Padgett speaks of several million shock absorbers being made within a period of three years. A production executive, working in such quantities, is prone to lose sight of the comparatively few units which must absorb engineering expense on machine tools. He sees the spindles and housing of the finished product but forgets the development charges that cannot be spread by quantity production.

It is a common habit today to complain of the price of most everything we buy. In the light of reduced income, all costs seem excessive. But if profits are any measure of fair prices, certainly the automotive industry has no just complaint on what it now pays for plant equipment.

The Mechanics of Recovery

Under the above title Dr. H. C. Dickinson, president-elect of the Society of Automotive Engineers, in a paper before the annual meeting of the society, has given a scientist's analysis of economic conditions that is most stimulating. We regret that space limitations do not permit the publication of the address in full. Dr. Dickinson's conception of money as the catalyst that is used to promote the flow of trade, yet is not consumed in the process, is novel and apt. So is his application of the conservation of energy principle of physics to a conservation of money principle in economics.

His conclusions are consoling, in the main:

The present depression can be dispelled, and that promptly.

Prosperity can be restored and made permanent.

These results can be accomplished without at all disturbing the capitalistic system.

The present trends of financial, business and political leadership are opposing recovery.

The natural forces of society are mainly acting toward recovery.

Recovery probably will take place in any case, slowly of its own accord, but rapidly if correct policies are followed.

Manufacturing Market Statistics

Those of us who have been badly in need of reliable statistics on industrial markets, and have had to plow through reams of census documents to get a rough picture of what we were after, should welcome this latest study from the Department of Commerce. It draws its basic information from the 1929 Census, it is true, and that census is a bit out of line with what a census of today would show, but still it gives

a picture of industrial markets that has never been available before.

One unfortunate thing about such a task as this one is that there is no way to evaluate its worth to American industry. Consequently, it is likely to be a target for legislative invective, and to be seriously depreciated by those who have no conception of its practical usefulness. Would that more of our governmental activities were as useful as this one.

• CHIPS •

Stagnation of funds in bank vaults and inability to expand credit point to probability of inflationary legislation in special session . . . Armed resistance by determined farmers to legal process of mortgage foreclosure adds seriousness to the prospect . . . Complete list of R.F.C. loans is published . . . Labor leaders threaten force and condemn bankers and politicians for failure to cure depression . . . Roosevelt studies cabinet eligibles and announces cardinal features of his policy . . . expects legislation that will give him wide powers.

Last lame duck session of Congress runs true to form . . . leaderless, conscienceless, resultless . . . Speed with which states ratified Norris amendment abolishing lame duck session and recognizing revolution in transportation and communication since writing of the Constitution shows how slow Congress has been to reflect public sentiment . . . To the credit side should go the extension of the Glass-Steagall act which saves the credit situation for many a bank . . . Chances for budget balancing, beer and economy diminish as session wanes . . . Half-billion, 2-year relief bill reported to Senate.

Stankozavod, Moscow machine tool plant, completes first series of 40 turret and semi-automatic lathes . . . scheduled to produce 500 machines in 1933, 6,400 a year by 1937, according to *Economic Review of the Soviet Union* . . . Prospects of inter-allied debt settlements improve as Hoover and Roosevelt agree on modus operandi so far as Britain is concerned, and British arrange to send delegation here . . . Other debtor nations open negotiations . . . Anglo-American Chamber of Commerce in London urges transfer of economic conference to U. S. . . . League of Nations and Japan near break . . . Japan breaches great wall of China to occupy Jehol . . . Chinese troops gathering, which means a great help to civilian China, according to observers who have watched the performance of Chinese soldiers when not busy at their trade . . . French cabinet falls because of budget strife . . . German cabinet does likewise but for a different reason.

National Electric Light Association disbands, cleans house, is succeeded by Edison Electric Institute . . . M. R. Hutchinson, former Edison chief engineer, reports spirit message from Mr. Edison . . . American Engineering Council condemns Technocracy for failure to follow accepted method of presenting engineering data to the public through regular engineering society channels . . . announces its belief that "our present economic structure contains within itself the possibilities of progressive improvement" . . . Columbia finds Scott's emulsion of technocracy unpalatable after all . . . regurgitates it and Scott, too . . . Chamber of Commerce of U. S. receives report from committee headed by Matthew S. Sloan proposing reductions of $800,000,000 in government expenditures . . . House passes bill to restrict government purchases to domestic products where available.

Atchison reports 17 per cent freight traffic gain, much above post-holiday average . . . Air transport lines report big gains in business . . . Toledo plants add 1,600 to payrolls . . . Checker Cab resumes at Kalamazoo, will employ 500 . . . I.C.C. orders power reverse gear to be applied to 31,000 locomotives . . . Index of employment in Cleveland rose 11 per cent in December . . . for the country as a whole there was no noticeable change . . . General Motors takes out license to use Bullard-Dunn process of electrolytically descaling metal . . . Dodge Brothers Corporation receives last of 21 Peerless chamfering machines for rounding of gear teeth in new helical transmission . . . A C Spark Plug plant orders 16 National Acme automatics and 4 Chronologs . . . Pennsylvania R.R. votes 50-cent dividend . . . completes N. Y. Division electrification . . . Loree buys into New York Central . . . General Motors moves to dominate air transport . . . Briggs strike stalls Ford production.

Various groups in construction industry sink differences and prepare for united action . . . Work starts, or is about to start, on San Francisco Bay and Golden Gate bridges, Los Angeles aqueduct and big Chicago pumping station . . . Stage 1 of Hoover Dam project completed a year early . . . Lidgerwood building 1,200-ft. cableway to lower 150-ton sections of 30-ft. pipe, welded by Babcock & Wilcox, from welding station to position at bottom of cliff 600 ft. below . . . specifications out for huge waterwheels . . . Bus-railroad fights on in 43 state legislatures . . . national battle awaits special session . . . In the mining field most of the activity is outside U. S. . . . Textile mill operations maintained at December level . . . rayon plants at capacity . . . U. S. exported more synthetic sodium nitrate in 1932 than it imported of the natural product from Chile . . . yet we propose to put Muscle Shoals into production . . . exports chiefly to Japan, Russia, France, Italy, which is probably significant.

Radical Changes in Automotive Design Foreseen at S.A.E. Annual Meeting

A surprisingly large attendance at the annual S.A.E. meeting in Detroit, January 23 to 25, clearly indicated a lively interest in the many problems now facing the industry. The subjects covered by the papers included legislation, rubber-tired coaches, aviation engines, riding quality and such details as automatic transmission and clutch design. There have been no radical changes in automobile design and construction in the 1933 cars, except body designs and equipment, and the discussions on aluminum cylinder heads, automatic transmission, automatic clutches and clutch design in general indicate that changes are not only being considered but are in the "incubator stage" as one engineer expressed it.

Opinion is by no means unanimously in favor of continuance of free wheeling. Automatic clutching apparently has more friends, and interest in automatic transmission seems to be reviving after having lain dormant since its trial and abandonment several years ago. Economy is demanded more than for some time, which gives the advocates of lighter cars, engines in the rear and really streamlined bodies, the opportunity of again airing their theories. There are also new and rather radical engine designs in the offing, one said to be under consideration by a large builder. These new motor designs are coming forward with the passing of the Knight sleeve-valve engine. Front drive enthusiasts seem to have given up the fight, perhaps because they foresee the change in engine location from front to rear.

Low pressure or super-balloon tires are having a much harder time in securing acceptance than their predecessors of more modest proportions. The balloon tire, it will be remembered, struck the popular fancy in 1923 and caused the hurried redesigning of many cars. Steering details, which were serious problems with the advent of the balloon tires, again require considerable revamping with the "doughnut." In fact, some insist that power steering devices must be perfected before the big tires can hope to find their way into general use.

One of the outstanding features of the meeting was the address of K. T. Keller on "Production, a Human Equation," a factor that is particularly important in times of financial stress. J. E. Padgett presented an excellent paper on "Some Principles of Flexible, Accurate, Low Cost Tooling," which was widely discussed. An extract of this appears on page 82 of this number.

If one can judge the future by the subjects discussed at this meeting, the automobile industry is again getting ready to make real progress.

Higgins Heads Norton Company

At the company's annual meeting, January 17, Aldus C. Higgins was elected president and general manager of the Norton Company upon the retirement of Charles L. Allen who has been president for 14 years and general manager for 47 years. Mr. Allen has been associated with Norton since the incorporation of the old Norton Emery Wheel Co. in 1885 and has been the only general manager of the firm.

Mr. Higgins, son of Milton P. Higgins, one of the founders and first president, has been associated with the Norton Co. since 1900, first as manager of research and abrasive plants, secretary from 1912 to 1919 and treasurer and general counsel from 1919 to 1933.

George W. Jeppson, vice-president in charge of production, was made treasurer to succeed Mr. Higgins. Other officers are Clifford S. Anderson, general counsel and secretary; W. La Coste Neilson, vice-president and general sales manager; Lewis E. Saunders, manager of research and abrasive plants, Henry Duckworth, assistant treasurer and comptroller; and Clarence W. Daniels, plant engineer.

CHARLES L. ALLEN

ALDUS C. HIGGINS

• INDUSTRIAL REVIEW •

Although actual machinery business in January has been small, sentiment is certainly somewhat better and inquiries have been larger in number, and more promising in character. Rehabilitation results are deceptive because many companies are refusing to permit their names to be used because they fear a mass attack by equipment salesmen. The better class of contract and tool shops are getting some interesting orders.

Detroit plants are operating on a four-day week, except where strikes have tied up everything. Strikers deserve sympathy if current reports of wage policy are correct. The local automobile show was well attended and brought out some buying. Sixteen screw machines went to a spark plug company and twenty-one gear tooth chamfering machines to a motor car plant. In Milwaukee the school board has inquired for two 14-in. lathes and a dozen woodworking machines. Rehabilitation is making strides in this section. Chicago finds things pretty dull.

About all the inquiries in St. Louis have been for used equipment. Bank failures have had the inevitable effect on local sentiment. In Indianapolis, too, business is practically at a standstill. Rehabilitation has not made much progress but machinery men are still able to eat. Sentiment in Cincinnati seems to be better although it has little to nourish it. Some of the machine tool companies are without orders.

Inquiries in Pittsburgh provide the principal news, but they are scattering. Some of the larger manufacturing companies in the district have been forced to reduce payrolls further. On the other hand, one company in Philadelphia has doubled its number of employees in the last two months. Orders are scarce here. In New York there has been a steady trickle of small business and January business will probably measure up to that of December. Boston reports no signs of any orders but a few good inquiries and encouraging activity in tool shops.

Hughes Made New Departure Manager

Effective January 1, the appointment of F. G. Hughes as vice-president and general manager of the New Departure Manufacturing Co. was recently announced by President De Witt Page. Other officers of the company were re-elected.

Starting as production manager in 1911, Mr. Hughes has held the positions of chief engineer, assistant general manager and vice-president. Previously he was experimental engineer at the Bethlehem Steel Corp. and chief engineer of the Driggs-Seabury Corp. of Sharon, Pa.

Mr. Hughes graduated from Yale University in 1900. During the war he was advisory engineer to the quartermaster department and a member of the war service committee on bearings. As chairman of the Ball Bearing Standardization Committee of the S.A.E., he was instrumental in effecting much of the standardization now so important in automotive production. He is also a past president of the A.S.S.T. and a member of the A.S.M.E.

Plating Patent Upheld

On January 23 the U. S. Supreme Court handed down a decision which reaffirmed the validity of Patent No. 1581188 granted to Dr. Colin G. Fink covering processes of chromium plating and the preparation of plating baths. The patent is now held by the United Chromium Co. Dr. Fink, who is professor of electro-chemisty at Columbia University, contended that his invention made possible a practical and commercially available process of chromium plating. This claim the court sustained.

Rise in Machine Tool Orders Continues

Up ten points from the July low point, the December index of gross orders, as reported by the National Machine Tool Builders' Association, is better than for any month since June. The three months' moving average of 31.7, which includes October's comparatively poor showing, does not reflect the full extent of the increase.

The year's average index of gross orders was 35.4 as compared to 73.9 for 1931 and 127.8 for 1930. The December figure of 35.8 is a little above the average for the twelve months of 1932. However, a simultaneous rise in shipments and unfilled orders is encouraging.

The December improvement is in the B and C groups, companies whose base shipments are less than $50,000 a month. The A group barely held its own. Relatively few companies are getting a large volume of business as only 15 of the 71 reporting show business better than 50 per cent of their respective bases. The companies reporting less than 10 per cent of their bases decreased from 53 per cent in November to 32 per cent in December.

	Index A	Index B	Index C	Total
Number of reports	24	26	21	71
Bases	$2,481,128	$608,173	$128,873	$3,218,174
Gross orders for month	33.2	38.7	72.4	35.8
Cancellations	0.4	0.3	2.3	0.5
Net orders	32.8	38.4	70.1	35.3
Shipments	30.8	28.3	81.8	32.3
Unfilled orders	39.1	65.1	72.9	45.4
Three-months' average of gross orders	31.7	87.9	43.5	31.7

Base — Average shipments for years 1922–24.
Index A — Base more than $50,000.
Index B — Base $10,000 to $50,000.
Index C — Base less than $10,000.
Total — The "total" indexes are not averages of A, B, and C indexes but are percentages of the totals of the respective items to the total bases of all reports filed each month.

Conference Board to Report on Unemployment Reserves

Prompt concerted action on the part of industrial leaders to guide and shape legislation is urged in a report now in press to be released shortly by the National Industrial Conference Board. This climaxes an intensive study of unemployment reserve plans during the past year by the research staff of the board aided by an advisory committee comprising a number of the country's prominent business executives.

The board points out that 43 state legislatures will be in regular session during 1933 and that in most, if not all, proposals for the establishment of state systems of unemployment insurance or reserves will be introduced. The report states that "Confronted by this situation industry cannot afford to pursue a policy of inaction. Consequences of the most serious import to industry must result if the formulation of an unemployment program is left solely to legislators and their more irresponsible and radical advisers."

Rehabilitation Move Shows Further Gains

Latest figures on total expenditures for modernization amount to $142,115,351 as reported by A. W. Robertson, national chairman of the Committee on Industrial Rehabilitation. One of the largest items is that reported by the Seventh Federal Reserve district committee showing that Swift & Co. plans to spend $2,500,000 to effect economies in the operation of its plant.

Projects involving expenditures in metal-working plants not previously reported in the Chicago district are: Crane Co., reconstruction oil burning equipment, $10,000; Barber-Greene Co., plant improvement, $8,780; Lyon Metal Products, Inc., tools, $8,260; Altorfer Bros. Co., modernizing equipment, $20,000; Allen-Bradley Co., repairs to plant, $35,000; Briggs & Stratton Corporation, new equipment, $5,000; Falk Corporation, $22,000; Cutler-Hammer Co., $25,000; Harnischfeger Corp., $77,270; Chain Belt Co., plant repair and equipment, $56,305.

In the Eighth Federal Reserve District (St. Louis) a number of metal-working firms have been added to the list: Liberty Foundry Co., construction of new core ovens and replacement of machinery, $25,000; Missouri Rolling Mill Co., extensions to buildings, $8,000; Wagner Electric Co., new equipment, $79,000; American Pulverizer Co., rehabilitation, $5,000; Chevrolet Motor Co., major repairs, $30,500; Fisher Body

Co., $30,500; International Heating Co., plant additions, $18,000; Sterling Steel Casting Co., installing heating plant $5,500.

The Fourth Federal Reserve district committee (Cleveland) continues its activity and reports the following new projects: American Steel Board Co., repairs to buildings and equipment, $7,000; Palley Mfg. Co., new dies and building repairs, $4,800; Aluminum Industries, new machinery, $5,000; American Can Co., building improvements, $8,000; Kelly-Koet Mfg. Co., new equipment and plant rearrangement, $10,500.

San Francisco shows further progress according to the Twelfth Federal Reserve district report. Additions to the list are: Standard Gas Engine Co. modernizing, $5,000; Laher Auto Spring Co., repairs and new spring machinery, $20,000; California Wire Cloth Co., electro galvanizing plant; $200,000; Pelton Water Wheel Co., new storehouse and toolroom, $5,000; Pacific Can Co., new equipment, $90,000.

The New England committee in the First Federal Reserve district reports new projects in the following plants: Baird Machine Co., general overhauling and purchase of tools, $100,000; Locke Steel Chain Co., patterns and jigs for new models, $10,000.

In commenting on the work of the committee, Chairman Robinson said, "The workers in our committees in the Federal Reserve districts and individual industrial and business centers are greatly encouraged by the activities of the many other organized groups working toward the common end of stimulating business and increasing employment."

Bausch Honored by Genesee Society

Edward Bausch, president of the Bausch & Lomb Optical Co., was guest of honor at the annual dinner of the Society of the Genesee on January 23 in New York City. Messages of greeting from President Hoover, Governor Lehman, Mayor O'Brien, and Dr. Robert H. Milliken, of the California Institute of Technology were read by Elon H. Hooker, toastmaster and president of the society.

One of America's early microscope builders, Mr. Bausch started when there were only eighteen microscopes in the entire country and devised methods of producing them so they could be sold at a low price. Before he completed his college course at Cornell, he was called home by his father to take over some of the responsibilities of the business.

Mr. Bausch was born in 1854 only a stone's throw from the Genesee River and spent his life building the extensive Bausch & Lomb Optical Co. on its banks. His neighbors and the nation honored him for a long list of scientific achievements.

EDWARD BAUSCH
Pioneered Optical Instrument Manufacture

Exports of Machinery During December, 1932

	Dec., 1932	Nov., 1932	Dec., 1931
Electrical machinery	$3,193,175	$3,697,630	$5,733,699
Power-generating machinery (except electric and automotive)	300,626	329,705	912,486
Construction machinery	254,463	175,000	634,078
Mining, well and pumping equipment	977,455	706,731	1,390,212
Power-driven, metal-working machinery	714,705	1,579,478	1,989,786
Other metal-working machinery	123,685	113,067	388,542
Textile machinery	333,932	286,684	560,073

Exports of Metal-Working Machinery During December, 1932

	Dec., 1932	Nov., 1932	Dec., 1931
Engine lathes	$14,250	$111,061	$57,643
Turret lathes	19,710	22,581	98,170
Other lathes	75,837	143,443	51,828
Vertical boring mills and chucking machines	11,286	50,516	131,449
Thread cutting, automatic screw machines	37,146	14,399	15,559
Knee and column type milling machines	20,241	48,243	13,299
Other milling machines	34,181	76,196	50,546
Gear cutting machines	83,361	67,556	68,713
Vertical drilling machines	4,047	60,785	24,911
Radial drilling machines	3,164	36,938	1,575
Other drilling machines	4,143	95,414	69,786
Planers and shapers	4,896	10,815	45,686
Surface grinding machines	4,705	2,850	57,672
External cylindrical grinding machines	9,154	5,958	54,182
Internal grinding machines	21,199	77,429	18,910
Tool grinding, cutter grinding and universal grinding	20,227	32,470	82,823
Other metal grinding machines	9,884	150,312	77,744
Sheet and plate metal working machines	135,556	349,926	226,764
Forging machinery	15,662	28,352	170,626
Rolling mill machinery	34,509	17,616	28,135
Foundry and molding equipment	17,402	32,403	53,070
Other power-driven metal-working machinery and parts	134,137	349,348	590,695

Other Metal-Working Machinery

Pneumatic portable tools	$26,655	$17,803	$65,741
Other portable hand-operated machines	19,545	20,575	47,648
Chucks for machine tools	3,358	2,673	8,862
Machine-operated pipe and thread cutters, stocks, dies, taps and other machine operated cutting tools	41,553	63,875	124,576
Other metal-working machine tools	32,574	30,823	141,715

•BUSINESS ITEMS•

Scully-Jones & Co., 1901 South Rockwell St., Chicago, Ill., manufacturers of production tools and machinery, have acquired the American Specialty Co., Chicago. The latter company manufactured a complete line of sleeves and sockets.

Stearns-Stafford, Inc., Lawton, Mich., has been organized to take over the Stearns-Stafford division of George P. Nichols & Brother, Inc., and will continue the manufacture of staggered roller bearings at the plant in Lawton. O. F. PACKER, general manager since 1923, has been appointed president and general manager.

Directors of the Mueller Brass Co., manufacturers of streamline fittings and parts, Port Huron, Mich., have voted to take over the Sky Specialties Corp., Detroit, manufacturer of airplane engine starters.

The Newton Meter Co., Newton Lower Falls, Mass., has started the manufacture of meters to be used in connection with oil burning equipment at 63 Walnut St. JACOB B. RIBAKOFF is president. Capitalization is $50,000.

The H. G. Machine Co., Quincy, Mass., has been formed to manufacture special machinery and to rebuild machines. C. GUY HYLAND is one of the principals.

The Timken Steel & Tube Co., Canton, Ohio, has appointed Delaware Steel Service, Inc., 1614 Summer St., Philadelphia, Pa., as its exclusive representative in the Philadelphia district.

WILLIAM G. NICHOL, formerly manager for the Milwaukee office for Neff Kohlbusch & Bissell, has opened an

office in the Mariner Tower, 606 W. Wisconsin Ave., Milwaukee. He will handle several lines of machine tools, cutting tools and special machinery.

Poole Foundry & Machine Co, Baltimore, Md., has appointed the Rockfield-Davis Equipment Co., 1500 17th St., Denver, Colo., as its representative in Colorado, Wyoming and New Mexico. The latter firm will carry a complete line in stock.

• PERSONALS •

HENRY S. DEMAREST has been elected president of Greene, Tweed & Co., New York, makers of small tools. JAMES A. MCKEON has been elected vice-president and HERBERT A. ERWOOD, secretary. WILLIARD R. PLATT, former president, and HAROLD B. PLATT, former vice-president, have resigned.

E. L. BERRY, shop superintendent of the plant of the Link-Belt Co., at 39th St., Chicago, has been placed in charge of manufacturing, engineering and erection.

PROF. JAMES A. HALL, professor of mechanical engineering at Brown University, has been made chairman of the Committee on Design of the Machine Shop Practice Division, A.S.M.E.

EARL L. RAMSEY, who has been in the general sales office of Ex-Cell-O Aircraft & Tool Corp., Detroit, will be production engineer working with the sales representatives in the different territories, effective February 1. Before joining Ex-Cell-O, Mr. Ramsey was the Buffalo branch manager for the Wm. G. Harvey Co., Syracuse, N. Y., which handled Ex-Cell-O products.

CHARLES N. ALVAREZ, formerly director of purchases of E. W. Bliss Co., Brooklyn, N. Y., is now associated with the Traumatic Institute, Inc., Brooklyn, N. Y., as vice-president.

• OBITUARIES •

Arthur L. Garford

Arthur L. Garford, president of the Cleveland Automatic Machine Co., and founder of the truck firm that bore his name, died January 23 at Elyria. He was 74. Mr. Garford first became nationally prominent through formation of the Garford Co., though prior to 1900 he had become a well-known manufacturer of bicycles and accessories. In 1912 the Garford Co. was sold to Willys-Overland, of Toledo. Later, Mr. Garford, who was also an inventor, organized the Cleveland Automatic Machine Co. of which he was president at the time of his death. He was also president of the Electric Alloys Co., Elyria, Ohio.

Clarence E. Whitney

Clarence E. Whitney, president of the Whitney Mfg. Co., and prominent industrialist of Hartford, Conn., died on January 22 at the age of 63. Mr. Whitney was born in Hartford the son of Amos Whitney, one of the founders of the Pratt & Whitney Co. In 1891 he

graduated from the Massachusetts Institute of Technology and later joined the Pratt & Whitney Co.

At the time of his death Mr. Whitney was also president of the Hartford Faience Co. and the Liberty Street Railway Co., and secretary-treasurer of the Hanson-Whitney Tap and Gage Co. He was founder or co-founder of all of these.

For many years, Mr. Whitney was a director and one of the strongest supporters of the National Association of Manufacturers. He was a leader in the organization of the open-shop conference of Connecticut and for its first two years was its principal financial supporter.

CHRISTIAN GALLMEYER, president of Gallmeyer & Livingston Co., manufacturers of machine tools and woodworking machinery, died recently. In 1912 Mr. Gallmeyer became interested in the Valley City Machine Works, and when a merger took in other concerns he became president of the resulting Gallmeyer & Livingston Co.

ROBERT C. HANDLOSER, manager of the Detroit office for the Motch & Merriweather Machinery Co., died recently. After spending some time with the Brown & Sharpe Mfg. Co., the Pond Machine Tool Co., the Nile Tool Works Co. and others, he went to Vienna, Austria, as representative for those firms. After other experience he joined the Motch & Merriweather organization in 1907 and from that date was in charge of the Detroit office.

WILLIAM S. PADEN, vice-president of Covel-Hanchett Co., Big Rapids, Mich., and associated with the company for seventeen years, died recently. He was in the machinery sales business for the greater part of his life.

H. F. J. PORTER, consulting engineer and industrial efficiency expert, died Jan. 25, aged 74. At the time of his death he was secretary of the National Museum of Engineering and Industry, New York. After holding advisory positions with several industrial concerns, Mr. Porter came into national prominence in 1893 as assistant chief of the machinery department in charge of the Machinery Hall at the World's Columbian Exposition in Chicago.

A. J. PORTER, superintendent of the Bridgeport, Conn., plant of the Heppenstall Co., died January 17. He was associated previously with the Bridgeport Forge Co., the former Bement & Niles Co., Philadelphia, and Tindle, Morris & Co.

HOWARD C. SIMPSON, vice-president of Raybestos-Manhattan, Inc., Bridgeport, Conn., died January 17. Previous to his last connection he had been superintendent of production for the Chalmers Motor Co. and production manager of the Hupmobile Co.

EDWARD F. LEEDS, former president of the Leeds Marine Engine Co., Bridgeport, Conn., died recently at the age of 56.

WALTER MCINTOSH, general superintendent of machine shops of the Manitowoc (Wis.) Shipbuilding Corp., died recently.

ROY L. MONGE, formerly indentified with Rockford Machine Tool Co., Rockford, Ill., died Jan. 10.

• MEETINGS •

AMERICAN MANAGEMENT ASSOCIATION. Annual meeting of the personnel division. February 7-8. Palmer House, Chicago. JOHN G. GOETZ, managing director, 20 Vesey St., New York, N. Y.

NATIONAL ALLIANCE OF ART AND INDUSTRY. Exhibition of new materials, new products and new uses. January 16 to February 15. National Alliance of Art and Industry, 65 East 56th St., New York, N. Y.

THE ROUND TABLE

"What's in a Name?"

"Say, Al," asked Ed as the two friends sat at lunch. "What is the name of your company; has it got any? Someone asked me what it was, and I couldn't tell him."

"Well, the next time anyone asks you, tell them it is Mason & Morton."

"Mason & Morton what? Manufacturing company or compressor company?"

"Neither, just plain Mason & Morton."

"Why don't you have a name that means something? Mason & Morton might be bricklayers or piano makers for all the information the name gives. Why don't you advertise the town or your compressor instead of just your two selves? People want to know what kind of a business you're in, what you make and where you are located. They don't care a rap what your names may be."

"When we started, Ed, we weren't thinking about advertising anybody or anything. We simply used the names that were good on a check."

"Sure, lots of people have started that way and have been sorry afterward. But you ought to correct it. Why not call yourselves the Rotary Compressor Manufacturing Company? Advertise your product?"

"Lots of companies have started out with high sounding names and been sorry for it, Ed. After a while they change their line or add to it, and the title doesn't mean a thing. The Blank Foundry Company, for instance, makes fine textile machinery, but they are handicapped by their name because people think of a foundry as making cheap machinery mainly to use their own castings."

"Well, why don't they call themselves the Blank Foundry & Machine Company? That's an example of what I've been talking about. Their title doesn't indicate their product."

"No, but it did when they started. When they added to their line the original name was a handicap. That's what we're trying to avoid."

"Yeah, you may be avoiding confusion, but you're courting oblivion. Why not be a good citizen and broadcast your town by naming your firm after it?"

"Yes, the Carlin Manufacturing Company would be enlightening, I don't think. We might be making vinegar, or silk hosiery or even steam engines for all anyone could tell. I don't agree with you about our names having no advertising value. Maybe mine or Mason's name hasn't any value at this particular time, but we're not ashamed to sign our names to our product. The name of the maker gives a personality to a product, like the Corliss engine, the Ford car or the Baldwin locomotive."

"Yes, or the Elgin watch, the Kalamazoo furnace or Key West cigars."

"Oh, there are instances of prominent locality merchandise, I admit, but when a stranger sees one of our compressors and asks what it is, I would rather someone told him it was a Mason & Morton compressor than a Carlin Manufacturing Company compressor."

"Sure you would. That's what I say. You want to shine in the reflected glory of your product. But when someone is told that it is a Mason & Morton compressor they'll want to know who Mason & Morton are."

"Well, Ed, I don't believe the success of our compressor will depend upon the name we give it. You would be no better scrapper if your name were John L. Sullivan."

"Maybe not, but people would remember it longer."

Is there any advantage in the kind of firm name chosen? Is Ed overestimating the advertising value of a company name?

Discussion

Corporation or Partnership?

Ed is all wrong when he tells Al that if his company were incorporated and wanted to get a loan some of the stock could be put up as collateral. The corporation would have to give a note, just the same as the partnership, and what is more the bank would undoubtedly ask both Al and Mason to indorse the note so that individual responsibility would not be escaped. The stock is useless as collateral because creditors come before stockholders. Credit managers are decidedly wide awake, and after incorporating, Al would probably find that the credit of the concern has shrunk to close to the vanishing point.

Probably the only case where incorporation would afford protection is in a suit for damages resulting from an accident, patent infringement, or other cause, and even here, the complainant might go after Al and Mason individually and get a judgment against them.

In the event of Al's death his widow's position would be just about the same regardless of whether she inherited half of the partnership or 50 per cent of the stock of a corporation. All told two

honest men are just about as well off operating as a partnership as they would be if the business were incorporated.

—C. J. Morrison,
Consulting Engineer,
Meyer, Morrison & Company.

No Mistakes

Frazer's action cannot be called a mistake. If Al had brought the special monel metal screens to his attention only once, I would say it was a mistake. But when Al reminded him of it again, when he was assembling the last lot of compressors, it was either negligence or disobedience.

Now that it is narrowed down to these two, there seems only one remedy and that is to replace Frazer, because negligence on the part of an employee in a key position is something which affects the morale of the whole plant, especially if it is a small plant. This is a matter which cannot be allowed to slide.

On the other hand, if it is disobedience, that is a condition which no plant, large or small, can tolerate. Orders are given to be obeyed and carried out according to the plans of the man in complete charge. If a subordinate does not obey the orders, it is high time to get one who will.

—Maurice H. Baitler,
Perkins Machine & Gear Company.

The trouble caused by the defective screen was primarily the result of bad management, and Al would most certainly wrong Frazer should he replace him. Frazer, being in charge of the shop and having forgotten to carry out certain instructions, was somewhat to blame, but Al, as his superior, was to a greater extent responsible.

Where Al erred was in giving Frazer verbal orders and not following them up with written confirmation. What he should have done was to have issued written instructions advising all concerned that the practice of applying perforated metal screens to the compressors was to be discontinued, and that monel wire screens were to be substituted on all new installations and orders for screen replacements. At the same time he should order the now obsolete perforated metal screens to be destroyed.

Had Al done this, it is most certain that Frazer would have carried out his instructions at once and thus made it impossible for any mistake to be made, so far as screens were concerned.

Al was again in error, when on reading the telegram, he lost his temper and proceeded to reprimand Frazer. Even the fact of Frazer's admission that he had used the wrong screen did not at once prove that this was the cause of the trouble, and Al should have tactfully withheld his reprimand until proper investigation has been made.

Frazer showed his caliber when he offered to correct the trouble at his own expense if it were caused by a broken screen. Al's fears that Frazer might minimize the trouble if sent to investigate were probably magnified by the ruffled condition of his mind at the time.

—Llewellyn Jehu,
Dominion Bridge Company, Inc.

Not minimizing Frazer's carelessness, the man who does not make mistakes does not do anything. Since the job was such an important one, why was Frazer entrusted with 100 per cent responsibility? Why did not Al check

Frazer when this job was assembled? Al would be the last one to claim that he never made a mistake. Why expect greater perfection from a hired mechanic?

One mistake does not prove unreliability. Has Al given due thought to the cost of hiring and breaking in a new man with all the possibilities of making more mistakes? Also, the amount of supervision required by this new man until he is even as competent and reliable as Frazer?

Perfect human being are not walking the streets, looking for jobs as compressor mechanics. What inducement has Al to offer to a man of this caliber?

Charging the expense of the trip to Frazer would be lesson enough to teach him to be more careful in following out instructions. —Louis John Lubin.

Branching Out

The partners should "branch out." They have engaged in business to make money; they are not engaged in riding a hobby of compressor building. It may often be a long weary way between compressor orders, but gadgets such as valves are wearing out with dependable regularity. Light, telephone service and postage stamps can often be paid for with the proceeds from such "chicken feed" business. In a small business such a trickle of ready money often means solvency.

The passing depression has shown that highly specialized business must have volume to live. Small one- and two-men concerns have shown an ability to live on small orders which are merely an expense to large firms.

—J. Carleton Esty.

Books and Bosses

More prices have been beaten down by firms operating without adequate cost systems than by any other one cause. Small inexperienced manufacturers seem to be the most prone to bankruptcy by the bookless route. Apparently many do not stop to consider what portion of the incoming dollar is their own and what rightfully belongs to their creditors. Cost keeping should start when the first step in production is taken.

The very smallness of the business gives Al and Mason an excellent opportunity to study costs. In their case, the cost of keeping minutely detailed costs will be no greater than getting only a general idea of them. They will no doubt get some surprises along with useful information from a good thorough checkup of every item entering into the cost of producing their products.

Both partners should be kept after school and given a spanking. Al says they pay no rent. Did Santa Claus give him his garage and the land it occupies, and does Santa pay taxes and repair the roof occasionally and pay the rent for Al's car in the garage next door?

Mason is certainly short-sighted in his attitude on cost keeping. Al should insist on doing the things that should be done to get into production. Mason should give him a hearty "go ahead" on the cost-keeping idea.

—Henry Schols.

Taking Chances

Al is careless and foolish to allow the patents to remain under Mason's name. Mason may have a strict sense of moral obligation, but one can never tell just what may happen.

When two people are engaged in business, and are partners, everything should be equally divided or else recorded in the name of both. This is not a sign of lack of trust in the other; merely a protection for both.

A verbal agreement is too indefinite, does not cover the necessary details, and too often is forgotten. When both partners have an equal responsibility, there is less chance of a break than there is when one partner feels that he has more work to do, and has more power.

Will Herman, *Superintendent,*
Tanenbaum & Son Oil Company.

American Machinist
Reference Book Sheet

Methods of Driving Straight-Shank Drills

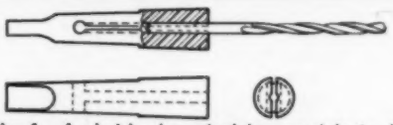

Fig. 1 - A slotted socket is provided with a hole the same diameter as the drill to be used

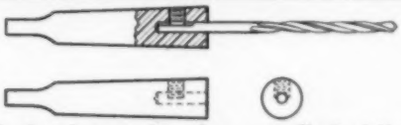

Fig. 2 - A setscrew bearing on a flat at the end of the drill shank does the driving

Fig. 3 - The slot is milled deeper than the hole and a flat is milled on the drill shank to engage the slot and do the driving

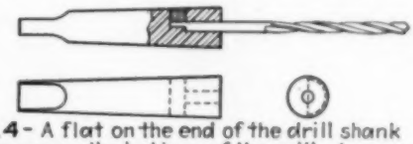

Fig. 4 - A flat on the end of the drill shank bears on the bottom of the milled groove of the socket. The groove is then filled with solder

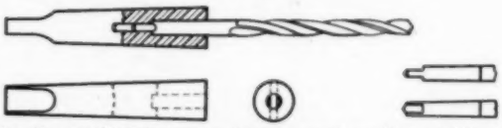

Fig. 5 - A slight taper is ground on the drill shank and flats are milled to suit the slot in the socket

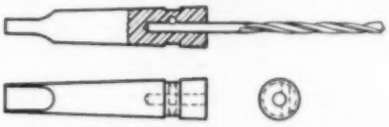

Fig. 6 - The drill is held in place and driven by the pin

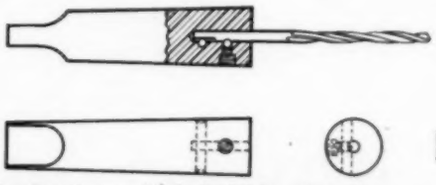

Fig. 7 - The drill is held in place by the ball and spring and is driven by the pin and flat on the end of the drill

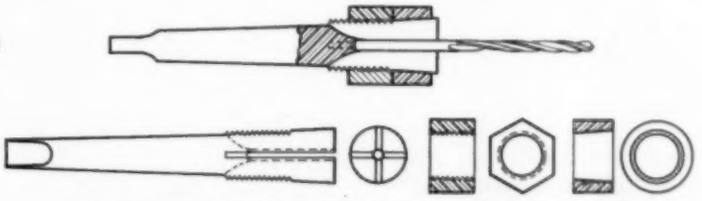

Fig. 8 - The driving friction is supplied by the nut and tapered collar

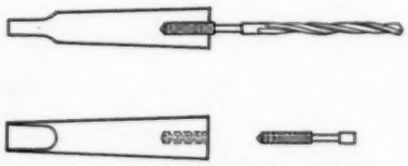

Fig. 9 - A simple threaded connection is used

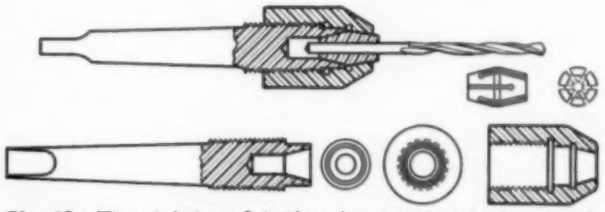

Fig. 10 - The driving friction is supplied by the double taper collet and special nut or hood

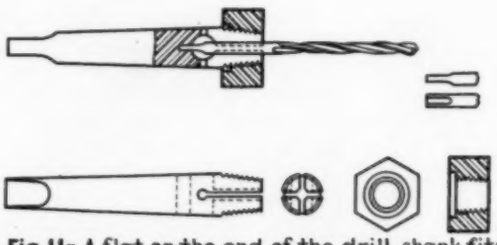

Fig. 11 - A flat on the end of the drill shank fits in a slot in the socket milled deeper than the hole. A tapered nut provides friction for locking the drill in place

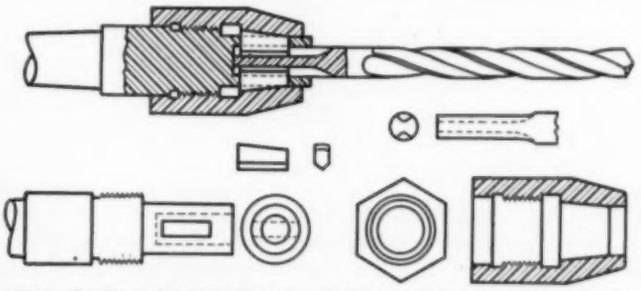

Fig. 12 - The drill shank is provided with two grooves into which the V-shaped jaws are fitted and made to grip the drill

Contributed by T. F. Githens, Mechanical Engineer, The Cleveland Twist Drill Co.

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Sharp-Corner Grinding

WALTER WELLS

Often it's better to grind a sharp corner than to avoid it

IN SPITE of the aversion that toolmakers seem to have for sharp-corner grinding, there are many instances where this process may be employed profitably. Whether they have a conviction that there is nothing to be gained by it or whether they feel that they can't get the exact grade and grain wheel from the tool crib, this aversion persists.

Nevertheless, it is a fact that sharp-corner grinding may be done expeditiously and accurately with a rather wide variety of wheel grades, once the principle or knack of preserving the sharp corner on the wheel is understood. When we consider that sectional dies are often designed with a view to eliminate all inside sharp corners by subdividing the sections to extremes and that this could be avoided by allowing for a reasonable amount of sharp-corner grinding, it is obvious that toolmakers must come around to this method sooner or later.

The drawing in Fig. 1 illustrates the above point. Here what would otherwise be five small rectangular sections are combined into one member. The accuracy required on this hinged-cover blanking die, both as to sharp corners and dimensions, may be maintained by grinding this piece integrally fully as well as by grinding the parts individually.

It is generally advisable to do grinding of this sort on a universal grinder. This machine has, first of all, a more sensitive cross-feed than the surface grinder, which is a big advantage. Furthermore, the travel of the table may be paralleled with the plane of the wheel to avoid the slightest drag on the cut, whereas a surface grinder is likely to be out of alignment. The job may be clamped positively to the table. Lastly, it will avoid tying up a machine that is frequently in demand for other shop work.

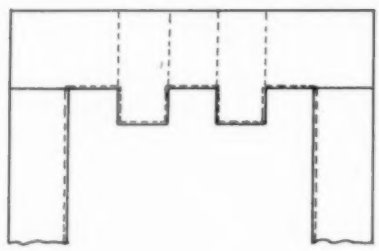


FIG. 1

FIG. 2

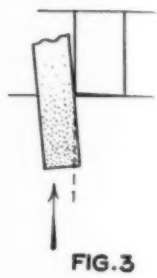


FIG. 3

FIG. 4

FIG. 5

FIG. 6

FIG. 7

Fig. 2 indicates the best way of dressing the wheel, leaving a corner not unlike a diamond tool. This is an enlarged view. In Fig. 3, there is an exaggerated representation of the drag that is likely to occur if care is not used. In Fig. 4 is shown the radius (enlarged about 20 times) that is generally left in inside corners after gashing with the hard-rubber wheel for depth and width. Here the wheel is shown in the wrong position for starting the clearing-out cut. No matter how carefully the grinding is started, nor how hard the grade of wheel, the first contact will blunt the keen edge of the wheel. This is because it strikes at the unfavorable 45-deg. angle which concentrates the entire stress of the cut on just a few abrasive grains.

An entirely different sequence of approach and procedure is necessary if the work is to be done to advantage. In Fig. 5, the correct first step is shown. The wheel is positioned to half the width of the radius and fed downward. The next step is to position the wheel at half the depth and feed in. Then, as in Fig. 7, the wheel is fed downward slowly to proper depth. Of course the first contacts must be made cautiously, even though the angle of approach is flat and saving on the wheel grains.

Allowances are made, of course, for the finishing skim of 0.0015 in., the wheel being redressed beforehand. It is then fed out and up like a facing tool in a lathe. If any suggestion of a radius remains, this may be cleared out readily by touching it up with the wheel after a second redressing. The 45-deg. angle approach does not cause any trouble in removing such a tiny bit of stock.

While a P-grade, 60-grain (Norton scale) wheel seems to be the best for this purpose, wheels somewhat harder or softer in bond, or differing slightly in grain, may be used, the principle being that a better job can be made with almost any wheel, provided that the correct sequence of cut is employed. In addition to sectional dies, sharp-corner grinding comes in mighty handy in repair and refitting work. It saves annealing and retempering. It is also recommended for dressing up punches, forming cutters and some types of counterbores. Not only 90-deg., but other sharp angles as well, may be ground in this way.

Tools for Deep Drawing in a Single-Action Press

CHARLES F. HENDERSON

WHEN SHELLS are required to be drawn from stock that is thin or of medium thickness, the work must generally be done in a double-action press. However, if no double-action press is available, such work can be done in a single-action press by a slight change in the usual type of pressure ring. Either combination tools can be used or the shells can be drawn from disks blanked in a separate operation.

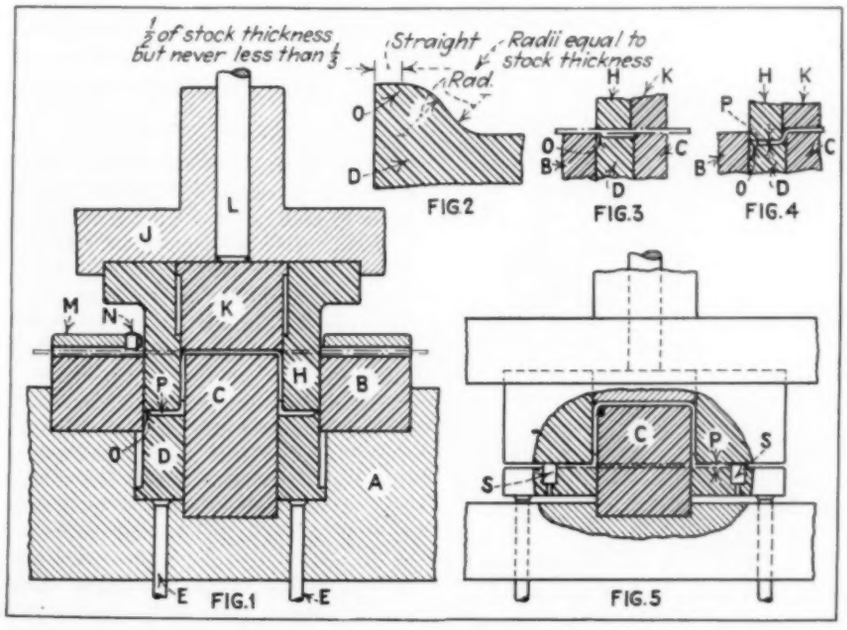
There is some objection to combination tools of the usual design, especially if the depth of draw exceeds one-half or three-quarters of the diameter of the shells, because the pressure on the blank between the pressure ring and the drawing die is constantly being built up by compression of the springs, or of the rubber pad, supporting the pressure plate, as the drawing progresses. This increasing pressure often causes the metal to stretch, or even to rupture, if it is comparatively thin, say not thicker than $\frac{1}{16}$ in. So, if there is no pressure regulating equipment available, the shells must be drawn from disks blanked in a separate operation.

Combination blanking and drawing tools having features making possible their use in a single-action press and to draw just as deep as can be done in a double-action press are shown in Fig. 1. For clearance sake, all screws, dowels and vent holes have been omitted. The cross-sectional view of the tools in the closed position illustrates a conventional design. The die-shoe *A* is counterbored to receive the blanking die *B*, the drawing punch *C* and the pressure ring *D*, this latter member being actuated by the pressure plate (not shown) through the pins *E*. The blanking punch *H*, which is also the drawing die, is fitted to a recess in the punch-holder *J*. The knockout *K* is a sliding fit in the drawing die and is actuated by the rod *L* from the knockout bar of the press as the ram nears the completion of its upward stroke. The stripper *M* and the locating pin *N* complete the major part of these seemingly common enough tools.

But in the construction of the pressure ring lies the secret of success. A section of this ring, greatly enlarged, is shown in Fig. 2. In facing the ring, the center is depressed, leaving at the outer edge the projection *O*, which is the same height as the maximum thickness of the metal from which the shells are drawn. To make clear the operation of the tools, the sections, Figs. 3 and 4 are given, in which the same letters refer to like parts in Fig. 1. In Fig. 3, the blanking punch has just touched the strip stock, the pressure ring being in its highest position. Continued downward movement of the ram shears the blank from the stock and carries it down, holding it between the projection *O* on the pressure ring and the lower end of the blanking punch. At this time the springs, or the rubber, supporting the pressure plate are being compressed. However, the holding pressure on the blank will last only until the beginning of the draw pulls it off of the projection, when the projection and the lower end of the blanking punch come into contact.

Referring to Fig. 4, the blank has been pulled from the gripping action noted above and is now in the space *P*, which is the same as the maximum thickness of the stocks, so that as the draw continues there can be no building up of pressure on the blank. The stock simply slides through the space *P* and flows around the rounded edge of the drawing die. The blank is ironed smooth by this action and all wrinkling is positively prevented.

The method described can also be used in a modified form for deep drawing where the blanking has been done in a separate operation. In that case, a series of hardened and ground pins, as at *S*, Fig. 5, take the place of the projection on the pressure ring. They can be so spaced that in a group of four or more they will form a locating nest for the blank.



Blueprints Used as Templets
Discussion

RICHARD OVERMAN
Maine Machine Works, Limited

In an article under the title given above (*AM*—Vol. 76, page 928), John Aures tells how he used blueprints as templets. Although his method seems to be all right, and may be so under certain circumstances, any one using blueprints in the way described should bear in mind that both the original drawings and the blueprints may stretch from the originally laid-out sizes. This is particularly true where blueprints are made in a continuous printing machine, in which the paper is stretched while hot.

Of course, where distances between points are small and clearances and tolerances are large, the stretching may not be a serious matter, but I have known of cases where blueprints have been stretched as much as $\frac{1}{16}$ in. per ft. in one direction of the paper. This experience has led to a complete ban on the never to be recommended practice of scaling blueprints in the shop, because accuracy in the drafting room cannot be extended through the fickle characteristics of blueprint paper and the various methods of making the prints.

My suggestion of a solution of Mr. Aures' problem would be to make the layout on a sheet of light-gage metal, drill small holes to center punch through and then from the sheet into a tube that will just slip over the pipes to be drilled.

• IDEAS FROM PRACTICAL MEN

Piercing Tools for Drawn Cups

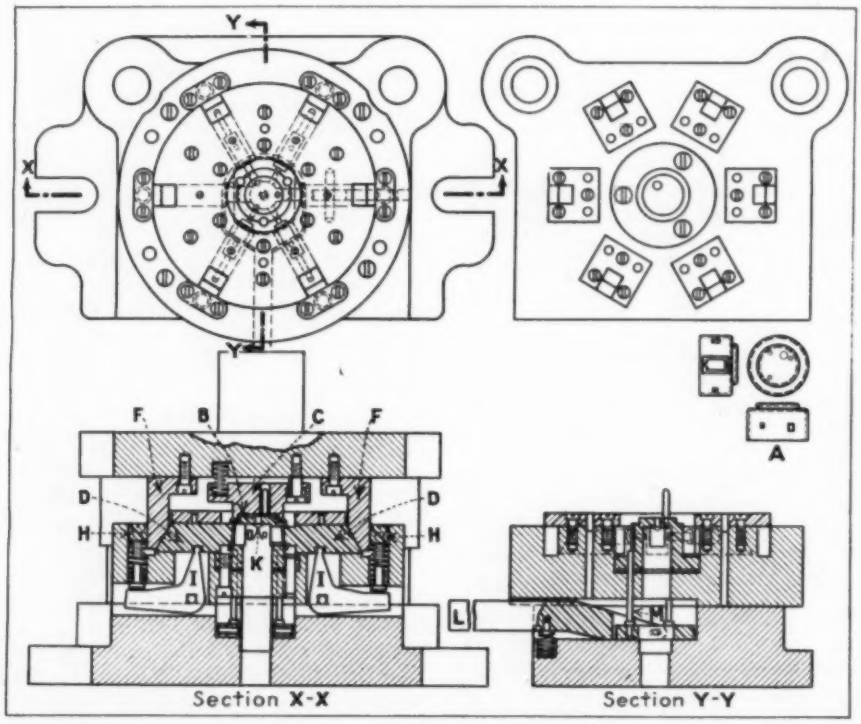
ARTHUR AMENDE
Machine and Tool Designer

When strongly constructed press tools are required for heavy side-piercing, the design illustrated has been found to be very serviceable.

The cup shown at *A* in the illustration is drawn from ⅛-in. cold-rolled steel and has six rectangular holes of different sizes pierced in its side by the tools illustrated. To avoid expense and cost of tool maintenance, the four round holes in the top were pierced in a previous operation rather than to incorporate this operation with that of side piercing.

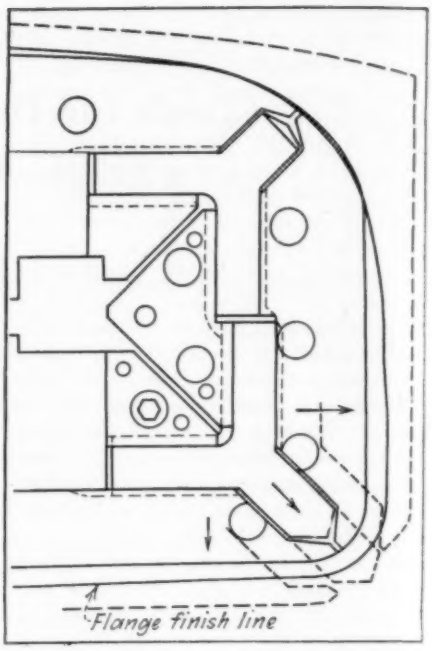
Designated by heavy black lines, the work is placed on the die-plug *B* and is held thereon by the spring pad *C* as the ram descends, being firmly held during the piercing operation. The six side punches *D* are evenly spaced radially and their cutting edges have a 2-deg. shear.

In operation, as the ram descends, the angular ends of the cams *F* contact with those on the outer ends of the punch-holders, forcing the punches inward toward a common center. The cams are backed by solid metal and the hardened blocks *H*. As the ram ascends, the punches are withdrawn from the work by the bell-cranks *I* through the pressure from stiff coil springs. The conical head of stud *K* breaks up the slugs as they enter the clearance hole in the die-plug. The slugs then fall through the hollow die-plug and through the tube below it into a receptacle beneath the press bed. Pressing down on the lever *L* forces up the knockout pins *M* and strips the work from the die-plug.



Simplified Wedge Dies

Wedge dies serve many useful functions both for perforating and for forming, but they are often needlessly complicated. To flange a drawn sheet metal body on four sides and in the corners usually calls for eight wedges. The illustration shows how the same result can be accomplished by four wedge actions. Wiping action in each corner is obtained by the stem of an auxiliary Y-member with forks at a right angle to each other and 45 deg. to the stem. Each branch of the Y slides in a groove



and it is the resultant motion of the two that produces the 45-deg. travel of the stem. If one wedge is slow in returning, freedom of action in the grooves prevents damage.

A Cure for Drill Breakage
Discussion

FRANK C. HUDSON

The cure for drill breakage as practiced by John Thomas (*AM*—Vol. 77, page 24) is interesting. We have however always been taught that a drill with unequal lips would not cut to size. Will Mr. Thomas tell us how much, if any, the drill point used enlarged the hole?

An Assembly Fixture for a Punch Press

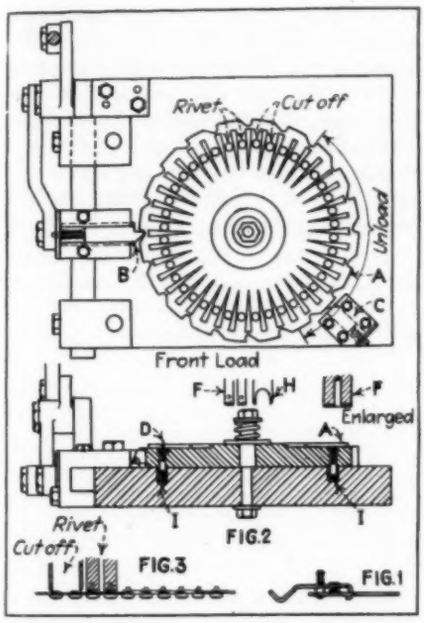
ANDREW BEUSCH

In the manufacture of contact fingers such as are shown in Fig. 1, tubular rivets in each member are connected by a shunt cable of copper in the first assembly. The fixture in Fig. 2 was designed to close the rivets onto the cable and to cut off the cable at each side of a pair of members, leaving them connected.

The dial *A* has 40 pockets, or nests, to accommodate 20 pair of members placed side by side. It is indexed by the pawl *B* which receives its motion from a bell crank operated by a connecting rod attached to the crankshaft of the press. The dial is prevented from turning backward on the return stroke of the indexing pawl by the pawl *C*. In

the illustration the position of the dial is shown when the press is at half stroke, so that the pawl *C* is between two index notches.

In operation, the tubular rivets are placed on the pins *D* and the members of the fingers are laid over them in pairs, the rivets entering holes in the members. Then the cable is wound around the rivets, as shown in Fig. 3. When the ram descends, the rivets in the first pair of members are closed on the cable by the riveting punches *F*, Fig. 2. As the ram ascends, the dial is indexed so that the rivets in the next pair of members are under the riveting punches and the first pair of members is under the cut-off



punch *H*. When the ram descends on the next stroke of the press, the cable is cut off on each side of the first pair of members, leaving them connected. At the same time the rivets in the second pair of members are closed on the cable.

The pins *D* are held in contact with the cam ring *I* by springs, and by the time the first pair of members reaches the unloading station the pins are over a depression in the cam ring and recede into the dial. In practice, about one-fourth of the dial is loaded at a time. The press is then started and runs until there is room at the loading station for another batch. The press is then stopped and another batch is loaded, when the press is again started. Eventually, the first batch reaches the unloading station, where it is unloaded and another batch is loaded when the empty nests reach the loading station. The fingers are completely assembled in another operation. The device not only gives a better product, but at a rapid rate.

An Automatic Clamping and Releasing Fixture

DUDLEY L. CURTIS

Handling small parts in manually operated jigs and fixtures is not always done with as much speed as may be required for a given output, often due to the time consumed in loading, clamping and unloading. With this thought in mind, the fixture illustrated was designed for milling slots in small brass pins, such as the one shown at *A*. The fixture is power driven and automatically clamps the work, feeds it over the cutters a predetermined distance and then releases it just before the loading position is reached, letting it fall by gravity. The only duty of the operator is that of loading and unloading the fixture.

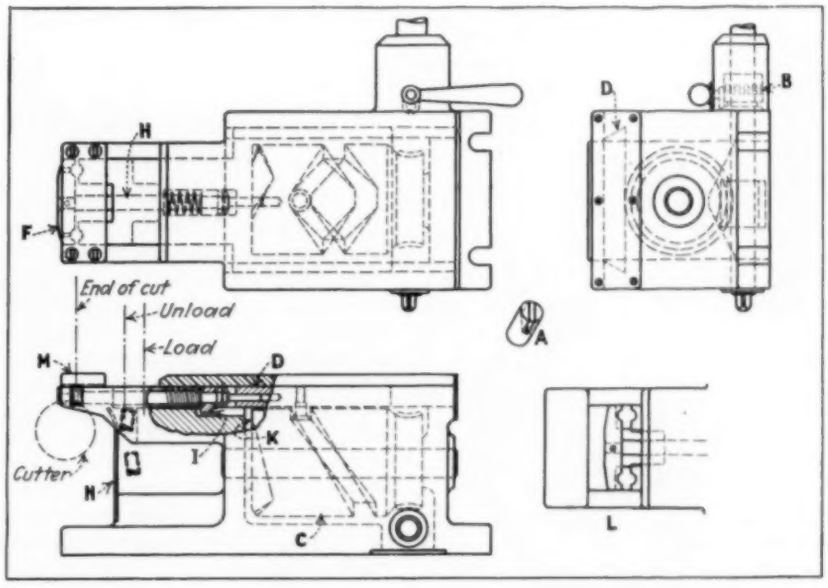
Power is taken from the feed shaft of the machine and motion is communicated to the fixture through worm gearing, the clutch *B* being provided for engaging and disengaging the feed independently of the machine drive. The barrel cam *C* moves the slide *D*, and one revolution of the cam completes a cycle of operation. At the end of the slide are two half-round grooves that correspond to the diameter of the work. At the same end of the slide is the clamp *F*, which also has two half-round grooves opposite to those in the slide, so that two pieces can be held at one time. The clamp is attached to the plunger *H* and is normally held in clamping position by a stiff helical spring. Just before the slide reaches the loading position, the heel of the collar *I* contacts with the end of the cam at *K* and the continued movement of the slide to the right compresses the spring and releases the clamp from the work, permitting the work to fall out of the fixture. The slide and the clamp are then in the relative positions indicated at *L* in the lower right-hand corner of the illustration.

As the cam *C* continues to revolve while the slide is in this position, there is a slight dwell in the movement of the slide, during which the work is loaded. At the left-hand end of the cam is machined a face cam that permits the collar *I* to move to the right under pressure of the spring, bringing with it the plunger and the clamp. This movement causes the clamp to contact with the work and clamp it by spring pressure. The barrel cam then moves the slide to the left, carrying the work over the cutters. The thrust plate *M* prevents the work from being forced upward under pressure of the cut. The guard *N* prevents the chips from getting into the mechanism and also prevents the work from falling into the space reserved for the chips.

Hardening Long Slender Tools—*Discussion*

E. J. TANGERMAN

Charles Kugler, under the above title (*AM*—Vol. 76, page 1233) speaks of hardening such tools as long, slender drills and reamers and keeping them from warping during hardening by rotating them at high speed in the chuck of an electric drill. A somewhat similar experience of mine may prove of interest and aid to others facing similar tasks. I was attempting to harden half a dozen chisel-steel blades for hunting knives, and they of course warped in hardening. Several methods were tried, but the only one that worked was to quench them in wet sand. A box of plain sand was wet thoroughly, and the knives, at temper color, were plunged into the sand edge downward so that the entire blade was



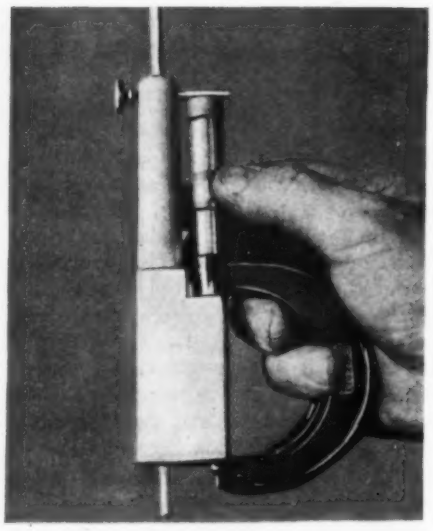
covered. The sand, while quenching more slowly than water, held the knife blades rigidly.

My father tells of straightening a warped and bent steel paper roll similarly. These rolls, accurately machined, are difficult to maintain in alignment, and unless perfectly true will tear the paper. It is common practice to discard a roll when it becomes too badly misaligned, but in this particular case a rush order was being run and no replacement rolls were available, except on two-week order. An attempt was made to straighten the rolls by peening on the side opposite the humps, but this only strained the metal further and resulted in greater misalignment. My father's solution was to heat a warped roll to red heat, then put it in a high-speed lathe properly supported by steady-rest and centers and to let it cool while rotating at highest possible speed. The only supervision needed was to assign a boy to keep the centers well oiled and to tighten them to maintain proper bearing as the cooling roll shortened. The finished roll ran true as a new one, simply because internal strains set up in use were relieved, and the roll naturally assumed its original form.

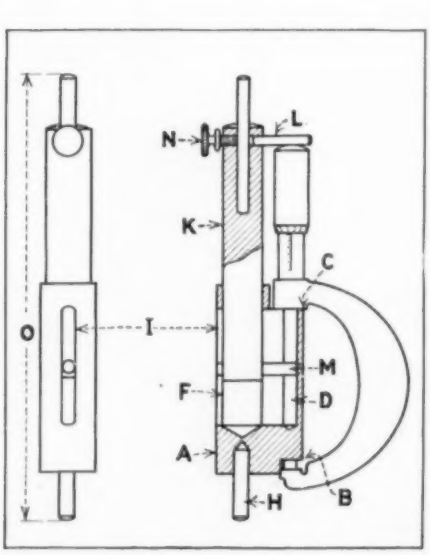
An Inside Attachment for an Outside Micrometer

A. KENDALL
Hamilton, Ontario, Canada

An attachment for converting an outside micrometer into an inside micrometer is shown in the illustration. Referring to Fig. 1, the body *A* of the attachment has a slot *B* to fit over the anvil of the micrometer and a step *C* at the opposite end, so that the micrometer frame will slide snugly into place. The hole *D* is a clearance hole for the micrometer spindle. Parallel with this hole and at the same depth is the hole *F*, and in line with it is a hole into which is driven the anvil *H* of the inside micrometer. The slot *I*, extending into the clearance hole for the micrometer spindle, completes the body of the attachment.



The plug *K* is a sliding fit in the hole *F* and is fitted with pins *L* and *M*, which are at a distance apart to permit the ends of the spindle and the thimble of the outside micrometer to fit snugly between them, so that the plug will move up or down as the micrometer spindle is screwed in or out. The plug is provided with a hole for inside micrometer spindles of different lengths, and a tapped hole for the binding screw *N*. The spindles are of drill rod and are accurately finished as to length, so that the overall dimension *O* is an even number of inches when the micrometer reads zero. In Fig. 2 the micrometer and the attachment are shown assembled and ready for use.



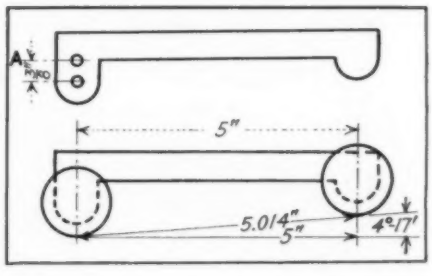
A Combination Sine Plate
Discussion

HENRY W. BOEHLY

Referring to the article by Edward Lay, under the title given above (*AM*—Vol. 76, page 795), the device illustrated is not in accordance with sine bar practice. As near as the illustration can be scaled, the center of the pivot is ⅜ in. below the center of the radius of the lug under which the gage block is placed, as shown in Fig. 1. This is wrong. The pivot should be at *A*, or on a horizontal line from the center of radius of the lug at the free end. If the usual sine-bar disks are placed on the device as now constructed, as shown in Fig. 2, a line drawn tangent to their lower edges will show that the sine bar part of the device is standing at an angle of which $\frac{0.375}{5}$ is the tangent, while the top of the plate is horizontal. This angle is 4 deg. 17 min., and the true length of the sine bar is the secant of this angle multiplied by five, or 5.014 in. instead of 5 in. as Mr. Lay supposes.

Then Mr. Lay further boosts up the free end of the sine bar by putting a 0.6252-in. block under it, and assumes that the height of the block divided by the length of the sine bar is the sine of the angle of the top of the plate. This is not correct, because the triangle he is working from is not a right-angle triangle, and his error of calculation becomes greater as the angle increases.

Since Mr. Lay has put a 0.6252-in. block under the free end of the sine bar, to find the angle at which the sine bar stands he must add to the block the 0.375 in. that is virtually under the free end and divide it by the true length of



the sine bar. The sine so found is 0.19948, representing an angle of 11 deg. 30 min. To find the angle at the top of the plate, 4 deg. 17 min. must be deducted from the angle at which the sine bar stands, giving an angle of 7 deg. 13 min., or 2 min. greater than is shown in his illustration. If it were necessary to set the top of the plate to an angle of 7 deg. 11 min., then the sine bar should be set at an angle of 11 deg. 28 min. and the height of the gage block would be 0.99678—0.375 in., or 0.6218 inch.

Assuming that the other member of the sine plate has the same error, then with a block of 1.8751 in. under the free end, the angle of the sine bar would be 26 deg. 40 min., and the top of the plate would be at an angle of 22 deg. 23 min., or 21 min. greater than Mr. Lay assumes. If it were necessary to set the top of the plate at an angle of 22 deg. 2 min., then the sine bar would have to be set at an angle of 26 deg. 19 min. and the height of the gage block would be 2.2228—0.375 in., or 1.8478 inches.

According to Mr. Lay's calculations,

if he wanted to set the top of his sine plate at an angle of 45 deg. he would use a block 0.70711x5=3.53555 in. A block of this dimension would make the sine bar part of the device stand at an angle of 51 deg. 15 min. and the top of the sine plate would stand at an angle of 4 deg. 17 min. less, or 46 deg. 58 min., giving an error of almost 2 deg., thus showing that as the angle increases the error becomes greater. If the top of the sine plate is to be set at an angle of 45 deg., a block 3.4253 in. will have to be put under the free end of the device.

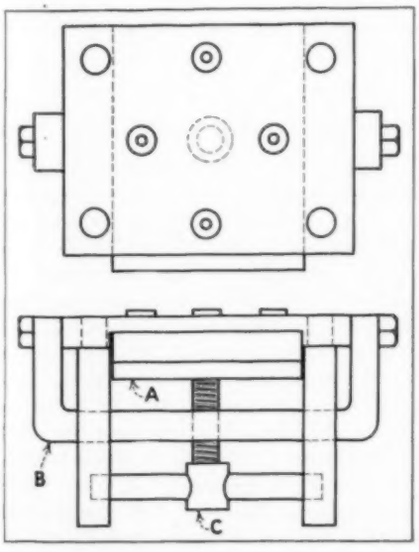
All the angles given are to the nearest minute only.

Drill Jig Fitted With Drills
Discussion

HERBERT P. HINCKLEY

Referring to the article by W. H. Moore under the title given above (*AM*—Vol. 76, page 1171), I am wondering if before Mr. Moore built his jig fitted with drills, he considered using a quick-change drill chuck and a standard type of drill jig. Offhand, it seems to me that the slight extra time to remove and rechuck each drill would about offset the time required by a high-priced mechanic to make the extra parts of the jig. When the job was finished, the shop would have a quick-change drill chuck that could be used on other jobs.

With the type of chuck to which I refer, drills can be changed in a very few seconds, and without stopping the spindle, about three-fourths of the time being spent in laying down one drill and picking up another. Since the capacity of this type of chuck is limited, it would be necessary to have one that would hold the largest drill needed and to bush the shanks of the smaller drills. In clamping the work to the jig, Mr. Moore used capscrews and a wrench. I would have used a pad *A*, a strap *B* and one or two clamping screws *C*, as shown in the accompanying sketch.

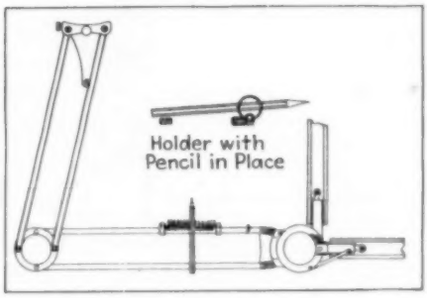


A Convenient Pencil Holder

G. A. HELBERG
Tool Designer, The Maytag Company

Nearly all draftsmen are bothered more or less by having their pencils roll on the sloping drawing board, or, in the case of large drawings, by keeping them in places where they are not convenient to reach.

A spring pencil holder attached to the drafting machine, as shown in the illustration, will obviate these troubles. No matter upon what part of the drawing board the draftsman is working, nor how large the drawing, the pencils are always within easy reach. The material required to make the pencil holder is some spring wire about $\frac{1}{32}$ in. in diameter; two pieces of soft steel about $\frac{1}{2}$x$\frac{3}{8}$, and long enough to make the two clips for holding the spring; two small machine screws; and two nuts to fit the screws. The wire should be wound into coils of about 1 in. in diameter. The holder can be attached at any convenient place on one of the bars of the drafting machine.

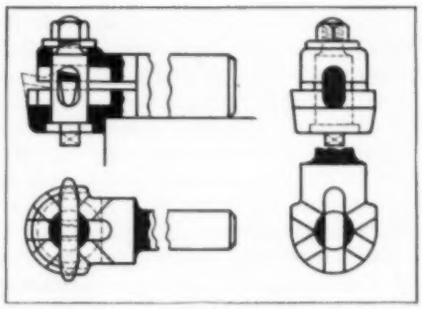


A Holder for Toolbits Tipped With High-Speed Alloys

J. T. TOWLSON
London, England

The illustration represents a toolholder that is especially adapted for holding toolbits tipped with high-speed alloys, and which I have found to give excellent results with the toolbits now in the market.

In the front end of the toolholder is a flat, circular base in which are half-round grooves for the toolbits, so that when clamped in place they cannot shift under pressure of the cut. The toolbits are entered through an elongated hole in the central bolt and are clamped under a cap having a half-round groove across it. The grooves in the holder may be at such angles as are most convenient, grooves at two angles, 45 and 60 deg. being shown in the lower views.



In the upper view, at the left, toolbits are shown in two positions in the holder, one in line with the holder and the other at right angles to it. The central bolt fits tightly in the holder. It can be turned so that the elongated hole is in line with any of the grooves by a wrench applied to the square on its lower end.

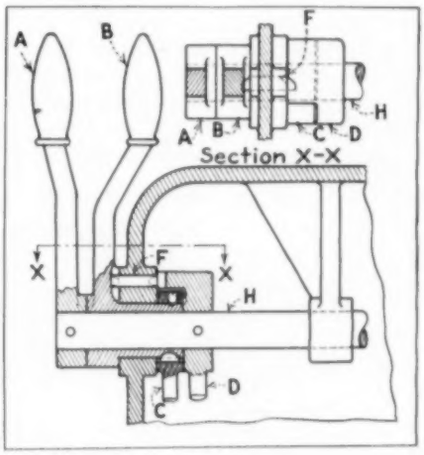
Interlocking Device for Gear-Shift Levers

E. F. EBERHARD

Gear-shift boxes are often designed so that each speed is obtained by shifting a separate lever, and unless means are provided for locking the levers, except the one to be shifted, clashing and possible damage to the gears are likely to result.

An interlocking arrangement for preventing such results is shown in the illustration. There are but two shifting levers, *A* and *B*, for transmitting motion to the links *C* and *D*, both links being connected to sliding-gear clutches. The levers are interlocked by means of the sliding key *F*. The beveled ends of the sliding key are engaged by beveled slots cut in the hub of lever *B* and in the upper projection of the link *D*. Incidentally, both levers are in neutral when they are in the vertical position.

Since the hubs of lever *A* and the



link *D* are both pinned to the shaft *H*, shifting the lever will rotate the link. When lever *A* is shifted in a clockwise direction, the beveled surface on the projection of the hub of link *D* forces the sliding key to the left and into the slot in the hub of lever *B*, thus locking that lever until lever *A* is returned to the neutral position. When lever *B* is shifted in a clockwise direction, the beveled surface of the slot in its hub forces the sliding key to the right and into the slot in the projection of link *D*, thus locking link *D* and lever *A* until lever *B* is returned to the neutral position.

It is obvious that with this arrangement it is impossible to shift more than one lever at a time, so that conflicting gear engagements are prevented.

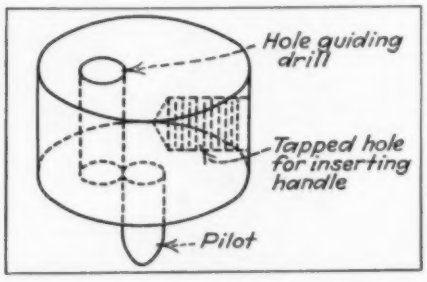
Jig for Drilling Holes Close Together

ERNEST C. ALLEN

In the sketch is shown a jig designed to aid in cutting various shapes from the solid metal when that operation is accompanied by drilling a series of holes close together. As will be obvious from the sketch, the hole for guiding the drill is tangent to the pilot, the pilot being of the correct diameter to enter the hole previously drilled.

In operation, a hole is drilled in the correct position in the work and the jig is put in place with the pilot in the hole just drilled. The next hole drilled, using the jig as a guide, will be so positioned as to have little or no wall between it and the previous hole. The operation is repeated until all the holes have been drilled.

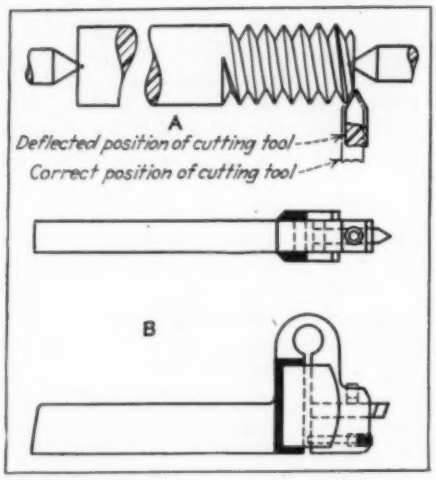
The jig may be made and used in a number of ways. If used as described, it is held in position by hand and can be manipulated to have the drill follow lines of any desired shape. By making the jig with two pilots, or by sliding it along a straight-edge, the holes can easily be drilled in a straight line. By attaching a rod of the proper length and provided at the end with a suitable center, the jig may be made to follow a circular path. It is needless to say that the accuracy obtained by the use of this jig is far in excess of hand methods, and that much less stock has to be removed in the cleaning-up process.



An Improvement in Gooseneck Toolholders

EMIL WITTMANN

Conventional toolholders of the gooseneck type have no provision for preventing deflection of the tool in the direction of the axis of the work. While this does not make very much difference in ordinary turning, it does make considerable difference when the tool is used for cutting threads. In this case, the



sidewise deflection results in the first thread being of too great pitch, as shown at *A* in the illustration.

To obviate this difficulty, the toolholder shown at *B* has plates welded on each side, the welding being done back of the spring slot. Since the plates extend well in front of the spring slot, they prevent sidewise deflection, while in nowise interfering with the functioning of the tool.

SEEN AND HEARD

JOHN R. GODFREY

Digging Up the Abrasive Ghost

Ghosts have a way of refusing to stay put. No matter how many times we prove, by etching surfaces and otherwise, that grains of absasive do not stay in cylinder walls or in other places when the job is done right, the old fear bobs up at fairly regular intervals. This time it comes through the T-C milling cutter advocates and refers to intake manifolds. These, as the story goes, were face ground until it was found that abrasive dust stuck to the inside of the casting and worked its way into the cylinders in spite of thorough washings. It is a bit difficult to imagine abrasives with such an affinity for the inside of castings. If T-C milling cutters can do a better job than grinding and for less money, they win the palm. But the "abrasive in the engine" reason seems a bit far fetched.

Rubber Tires Save Floor Wear

Floor maintenance has always been quite a large cost factor in large plants. The action of truck wheels is mainly responsible for excessive wear on floors, and this is being largely overcome in some places by using trucks with composition rubber treads. Truck casters of this kind which are fitted with self-lubricating bearings and bakelite body have been found especially effective.

Worm-Geared Winches

The hand-powered winch has seen improvements, and as a result is staging considerable of a comeback, some factories finding it a tool of many uses. One little winch to which my attention has been especially drawn is fitted with a worm gear reduction. This not only makes it more powerful, but also safe, as it is self-locking. It is very handy to maintenance men. Some use it for lifting gates, ladders and walkways. Others find it useful for handling chucks, motors, heavy castings and whatnot.

File Hardness

Hardness testing has undergone great changes since the days when we depended entirely on the file. "File hard" has long been a term that denoted extreme hardness, but that of course varied with the temper of the file, with its condition and with the man who used it. We've gone a long way in testing hardness, but the file still remains as a sort of check in many hardening rooms. "File hard" rarely means exactly the same thing in two shops. But the man who knows how can tell a lot with a good file.

Jam-Proof Conveyors

Among the features noticed on latter-day conveyors is a jam-proof device at the intersection of live rolls, which permits packages to be gathered from various points over the plant, and all carried onto the main conveyor for delivery to their final destination. If two packages approach the intersection at the same time, one of them is automatically held back by a short belt that is inserted into the conveyor for that purpose, until the main line has become clear. Where movement of stock from various points is in any way complicated, such a feature is of great value.

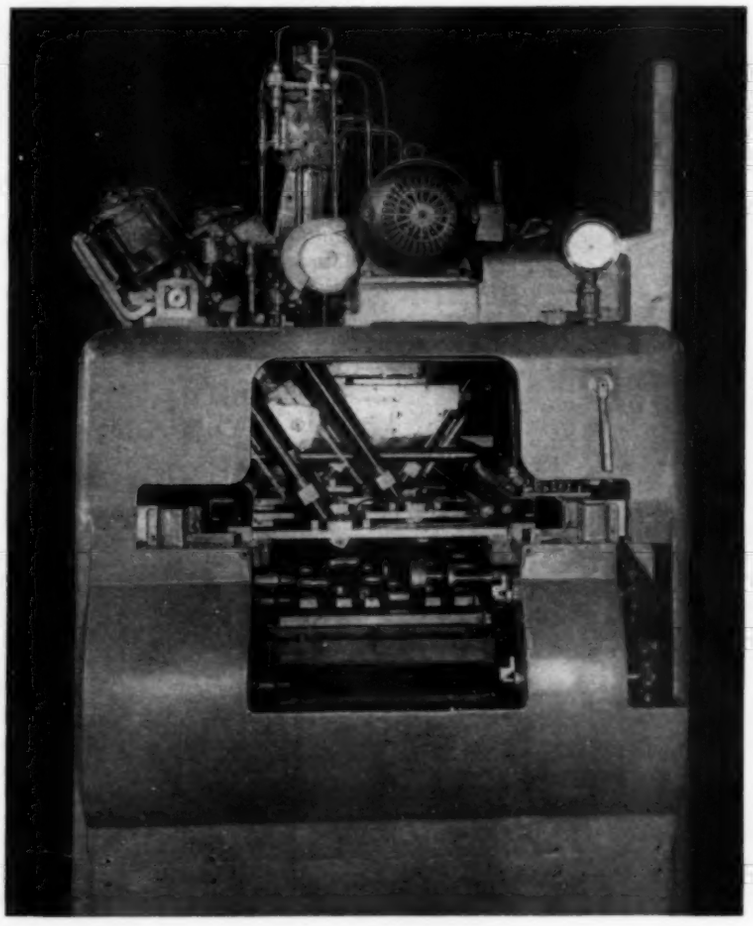
SHOP EQUIPMENT NEWS

Davis & Thompson Crankshaft Drilling Machine

Sixty crankshafts per hour are drilled for oil holes on the crankshaft drilling machine developed by Davis & Thompson Co., 6619 W. Mitchell St., Milwaukee, Wis. The machine drills a $\frac{3}{16}$-in. hole that passes from the crankpin through the shaft and out through the main bearing, making four holes in each shaft. The hole is 5¼ in. deep. The machine is entirely automatic in operation, and drilling is done by the step method, utilizing Vickers units. Indexing is accomplished by hydraulic cylinders. The machine is double indexing.

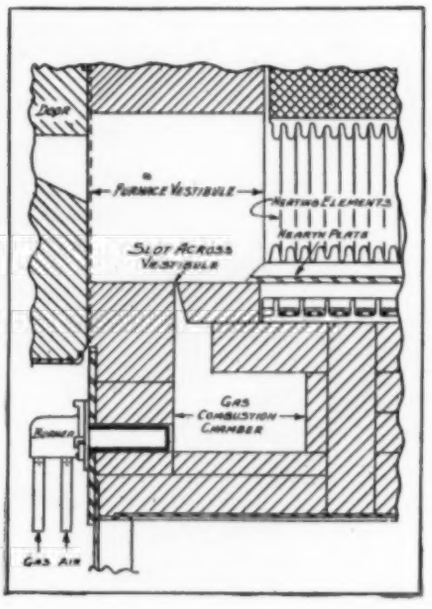
As soon as the indexing is completed the drilling starts. While the drilling operation is in progress the operator removes two crankshafts and replaces them each time the machine indexes. Operation of the machine can be stopped at any part of the cycle by the lever shown at the top right-hand corner of the machine. There are 22 shafts in the machine when it is fully loaded. The crankshafts are loaded and unloaded at the front end of the machine.

The machine is equipped with four drill heads, each one being driven by an individual motor. Each head carries two drills, each one of the drills drilling a separate crankshaft. The shafts are rotated to bring the proper pins into the correct position by gears engaging a stationary rack. After the crankshaft is drilled the fixture passes off the rack and is prevented from turning by ball bearings which serve as rollers. The rollers located in the center of the links carry the crankshaft on the return. All tracks and wheel treads are of alloy steel, hardened and ground. All gears and racks are also made of alloy steel.



Atmosphere Control for Hevi Duty Furnaces

Atmospheric control for box-type or conveyor-type furnaces has been developed by the Hevi Duty Electric Co., Milwaukee, Wis. As shown in the accompanying drawing, a small combustion chamber is built into the bottom of the furnace vestibule, which has in connection with it, gas and air inlet pipes, valves and a burner. The combustion chamber has a slot opening into the vestibule and completely across it. Through this slot the products of combustion coming from the combustion chamber will rise as a uniform transparent screen across the opening of the furnace. The pressure of this screen is



sufficient to displace all oxygen bearing atmosphere previously present in the furnace chamber and will prevent the admission of outside atmosphere. The most important use of the atmosphere control is to protect the charge during the heating and soaking period.

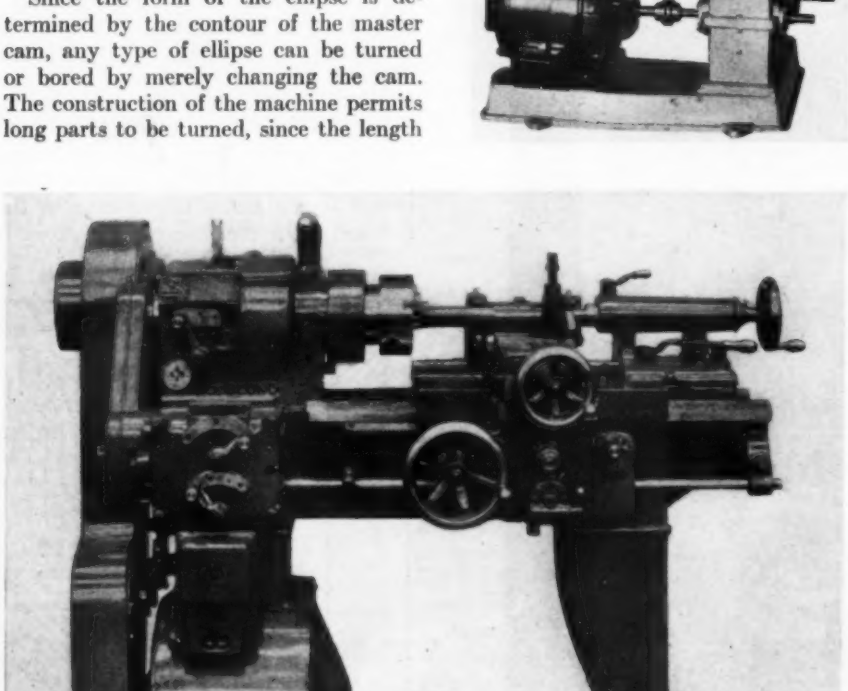
An arrangement is also provided on the box-type furnace so that when the door is opened the volume of gas is increased to a greater proportion than air so as to compensate for the greater volume of air at the time the door is opened.

LeBlond Elliptical Turning Lathe

The R. K. LeBlond Machine Tool Co., Cincinnati, Ohio, has developed an elliptical turning lathe suitable for turning punches and mandrels or for boring elliptical holes. A standard 11-in., geared-head, rapid-production lathe was used as the basic machine. A splined shaft is geared to the spindle nose and is supported by the headstock and two brackets on the rear wing of the carriage. Carrier brackets are rigidly held in position and are spaced on opposite sides of the carriage bridge as shown. The master cam is mounted between these brackets and is rotated by the splined shaft.

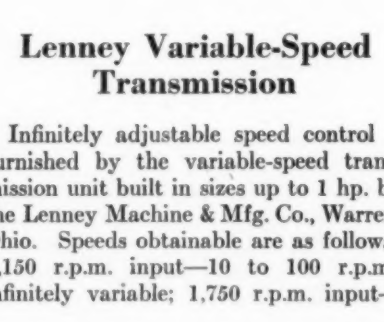
The roller which contacts this cam is mounted in a bracket in the center of the bottom slide. The bracket is cast integral to insure rigidity. It is located back of the cam so that the cam will pull the tool into the work. The cam follower is held in contact with the cam by two coil springs.

Since the form of the ellipse is determined by the contour of the master cam, any type of ellipse can be turned or bored by merely changing the cam. The construction of the machine permits long parts to be turned, since the length of the work that can be machined is only dependent upon the length of the splined shaft and does not necessitate the use of a long master cam.



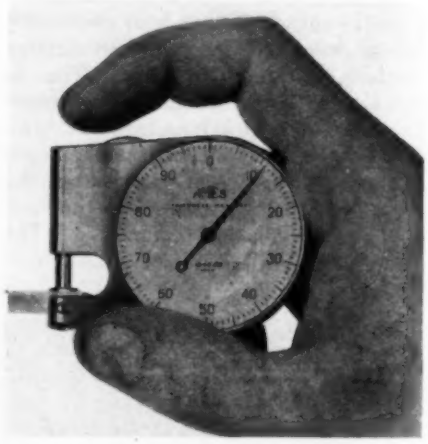
Lenney Variable-Speed Transmission

Infinitely adjustable speed control is furnished by the variable-speed transmission unit built in sizes up to 1 hp. by the Lenney Machine & Mfg. Co., Warren, Ohio. Speeds obtainable are as follows: 1,150 r.p.m. input—10 to 100 r.p.m., infinitely variable; 1,750 r.p.m. input—15 to 150 r.p.m, infinitely variable. The unit is irreversible, but can be built to run in either direction.



Ames Thickness Measure

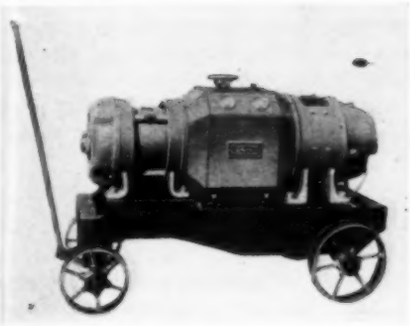
Designed to fit the vest pocket like a thin model watch, the thickness measure developed by B. C. Ames Co., Waltham, Mass., is a low-priced dial thickness gage, which has the dial graduated in thousandths, and which indicates plainly measurements to half-thousandths. The number of graduations the pointer passes as the anvils are opened are counted and may be compared with the chart stamped on the back of the gage to determine the nearest fractional equivalent. Movement of one finger turning the operating wheel opens the anvils to admit work being measured. The indicator has no sharp corners or projecting parts and is made of non-rusting metal and with an unbreakable crystal. The pointer is adjustable to zero, and all parts are replaceable.



Wilson Model S.A. Arc Welder

A four-bearing, self-excited, dual-control arc welder, known as the Model S.A., is now being built by the Wilson Welder & Metals Co., Inc., North Bergen, N. J. This machine is built for high amperages and arc voltage required in speed and shielded arc welding. It is a two-unit machine with a flexible coupling, which permits the changing of the motor or the generator in case of failure. The only projecting parts are the control handles, and these are placed so that they are safe from injury.

By means of the dual-control system, the voltage and amperage may be set independently. The instruments may be read with ease. The machine will



weld at the rated current in amperes, with 40 volts across the arc, i.e., a high-speed shielded arc. It does not require an exciter, and provides sparkless commutation at all loads. It is equipped with dead-front controls.

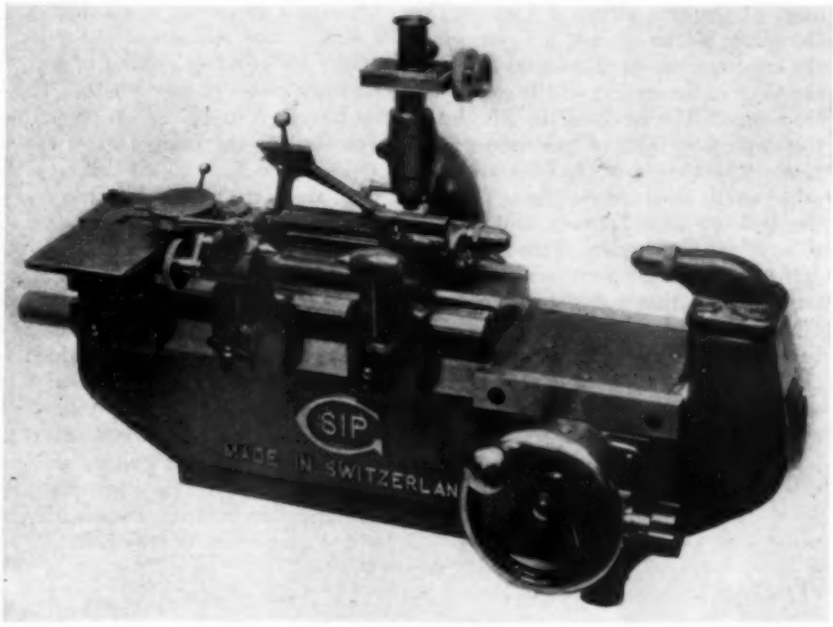
Toledo Vibrator Filling Machine

Packaging of such parts as nails, pins, washers and nuts, which are ordinarily difficult to handle, can be done with the vibrator filling machine recently announced by Toledo Precision Devices, Inc., Toledo, Ohio. This device controls the automatic feed of the materials from supply bins to the scales and the automatic weighing out of predetermined amounts in packaging operations.

The vibrator filling machine consists of a Toledo scale, an "electric eye" cutoff attachment and a vibrator holding the articles to be packaged. Weights equivalent to that of the filled container are placed on the weight platter of the scale. The vibrator, attached to the scale, is supplied with the commodity from a large hopper or bin placed nearby. The operator presses a button which puts the vibrator in motion and the articles run into the container. At all times the operator can watch the progress of the flow by glancing at the scale chart. When the predetermined amount has entered the receptacle, the electric cutoff stops the flow by stopping the vibrator. The equipment is capable of filling as many as 200 one-pound containers per hour to a tolerance of $\frac{1}{16}$ of an ounce. On larger drafts, material can be measured out at a speed of tons per hour.

Société Genevoise Model MU-100 Universal Measuring Machine

A universal measuring machine in a small size, designated as Model MU-100, has been developed by the Société Genevoise d'Instruments de Physique, Geneva, Switzerland, and is being offered in the United States by their agents, The R. Y. Ferner Co., Investment Bldg., Washington, D. C. The capacity of the machine is 100 mm., or 4 in. It can be supplied graduated in either inches or millimeters and reads to an accuracy of 0.00005 in. or 0.001 mm. Its field of use covers the checking of plug gages both as to diameter and cylindricity, the measurement of pitch and three diameters of thread gages, the testing of the gap of snap gages, the determination of pitch, diameters and also of the relief of taps, and the calibration of various other calipers, micrometers and pieces with either spherical ends or parallel faces. The machine has the advantage of referring the work directly to a line standard, avoiding the intermediate step of establishing a reference end standard.



Measurements on this machine are made by the use of a Société Genevoise micrometer microscope, reading on a glass scale having a temperature coefficient practically equal to that of steel so that temperature errors are avoided. The scale is illuminated from below by means of a light from a lamp on a 110-volt circuit. Accuracy is further insured by constant measuring pressure. Bed of the machine has fixed contact anvils at

each end, the left one for snap gages. A slide between the two anvils rolls on steel balls and carries the movable anvils and the glass scale. Displacements of the slide are read directly by the measuring microscope. Rapid movements of the carriage are made by a large handwheel at the front of the machine. The handwheel is provided with a slow-motion device for final settings.

The anvil at the right end of the carriage and that on the right end of the machine bed are optically flat and are made of synthetic sapphire. For external measurements either a flat measuring table mounted on balls, or one carrying centers similarly mounted for the support of plug and thread gages is supplied.

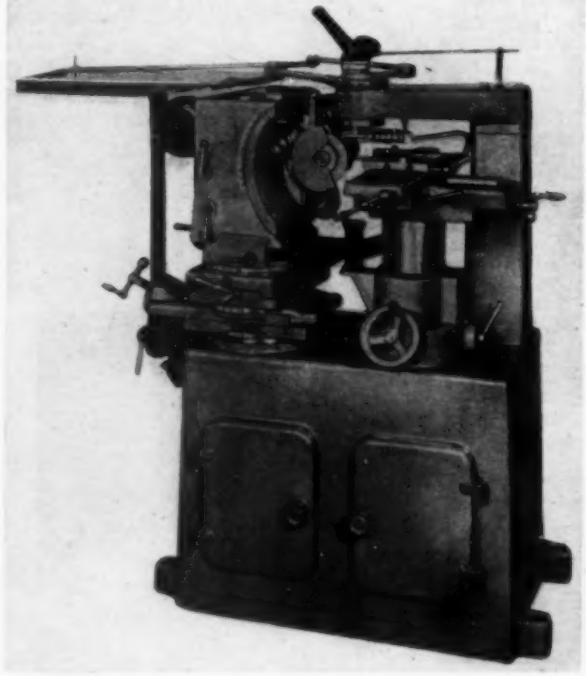
For internal measurements of snap gages a method of making contacts has been developed which permits establishment of the zero setting by pressure of the spring piston against the carriage in the same manner as in external measurements or in the setting on the gap of the snap gage. The anvil on the left end of the carriage consists of two flat-surfaced pieces separated by a gap permitting the other anvil, mounted on the left end of the bed, to pass between and beyond them when the carriage is moved to the extreme left. This movement is carried far enough so that a flat block-type gage of 0.2 in. thickness can be placed between them. This permits establishment of the zero setting when desirable in the same manner as the setting on the snap gage, and both are made by movement of the carriage in the same direction as external measurements and with the same contact pressure. A table for support of the snap gage is clamped in a T-slot extending lengthwise of the bed so that the table can be set in the proper position.

Beside external and internal measurements, the machine provides for the measurement of the pitch of taps. The center supports at the front of the machine, the dial indicator and the triangular frame work seen on top of the carriage are used for this purpose. The triangular frame carries a conical contact point which can be lowered by pulling the top of the frame forward and downward, until the contact point or feeler rests between the threads of the tap mounted between centers. Four sizes of feelers are supplied for use with various pitches. The dial indicator is used only as a zero instrument and any errors of its rack and gears do not enter into the measurement. This attachment for measuring pitches of taps has been found to give precision of 0.00005 in., equal to that of other measurements with the machine.

The machine measures 25x18x16 in., and has a net weight of 128 lb. The table with centers for the measurement of plug and thread gage diameters has a maximum distance between centers of 8¾ in. and admits plugs up to 2 in. in diameter. Flat pieces, disks or the ends of plug gages up to 4⅜ in. can be measured when supported on the flat table. Taps up to 9½ in. long can be supported between the centers for pitch measurements.

Naumann Improved Profile Grinder

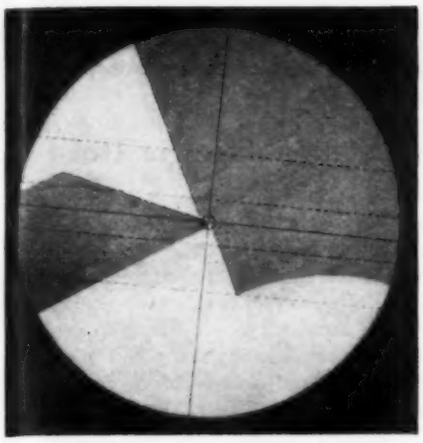
Grinding form tools and gages directly from hardened steel can be done on the Naumann profile grinder, distributed in the United States by the George Scherr Co., 128 Lafayette St., New York, N. Y. The machine illustrated is an improved model, being considerably different in appearance from the earlier model (*AM*—Vol. 75, page 367), although the principle of operation is retained. As now arranged the machine is equipped with a box-type bed, on the inside of which is a tool chest and a dust exhaust system. The position of the work slide allows for grinding profiles of 6 in. long on work pieces of any length. This can be increased to 9⅞ in. on special order. For limiting the movement of the work slides in the longitudinal and cross direction, stops are provided in the center of the guide ways. These stops are made in such a way that standard gage blocks can be used. Dial indicators are attached to the stops. To provide rapid traverse of the longitudinal slide over a longer distance, an arrangement is provided for a quick motion of 2 in. Vertical adjustment of the work slide is by means of a round column. The several swivel bases in the wheelhead and slides are graduated and have verniers to read directly in 6 minutes of arc. Illumination from above and below is provided.



Further improvements have been embodied. The side clearance motion can be set while the machine is running, thus rendering it possible to relieve a tool (starting from the front clearance) not only on the right hand side face but also on the left hand side face. The stroke of the grinding wheel has been increased to 2 in. Two speeds have been provided for the stroke of the wheel, and these may be obtained while the machine is in motion. The magnification of the optical system has been increased to forty times.

Accurate grinding of the profile is secured by employing a drawing 50 times actual size and using a pantograph arrangement with a 50 to 1 ratio. The pantograph actuates a microscope having a magnification of forty times. This microscope has cross hairs with a circle at the intersection of the cross hairs. The profile of the workpiece is thrown up on the microscope screen and the wheel is fed to the circle at the intersection of the cross hairs. As the pantograph is moved from point to point on the drawing, the wheel is fed from point to point on the work. The feeding of the grinding wheel is effected by means of two grinding wheel slides. If a straight surface is to be followed, the slides are set and the profile is obtained automatically. It will be seen that the grinding wheel head proper has two sets of circular slides at right angles to each other, so that relief can be ground on the tools. The stroke of the grinding wheel is set vertically and the vertical adjustment of the grinding wheel head is determined by an indexing bolt. Vertical operating movement of the grinding wheel spindle is obtained from a small motor and gearbox. An adjustable eccentric drives the grinding wheel slide. A fast stroke, neutral, and a slow stroke are provided.

Since the drawing is made 50 times actual size, it is possible only to grind a small portion of the profile with the

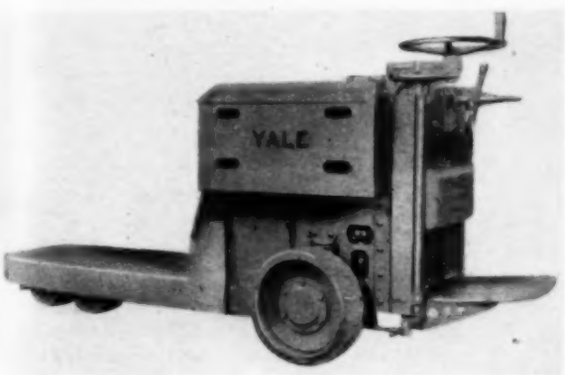


Microscope image of work on Naumann Profile Grinder. The wheel is fed to the small circle. Accuracy is independent of wear of the wheel.

full pantograph movement. Therefore, the design of the mechanism is such that 0.4 in. along the profile is ground. The drawing is made in sections. After 0.4 in. of the profile has been ground, another sectional drawing is placed on the table and the pantograph is returned to the initial position. At the same time, thickness blocks are removed at the slides. Each slide for the workpiece accommodates a stack of such blocks and stops are provided. Dial indicators are set to the stops. Profiles 6 in. long can be ground on workpieces of any length. The work is illuminated both from above and below.

Yale Heavy-Duty Low-Lift Truck

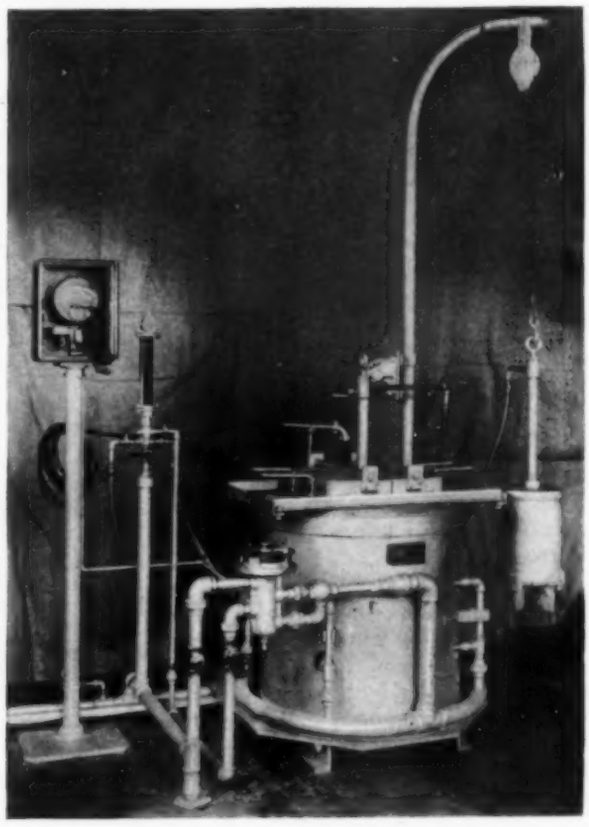
For heavy-duty transportation service, the Yale & Towne Mfg. Co., Philadelphia Division, Philadelphia, Pa., is offering the Model K26S10 low-lift truck with a rated capacity of 10,000 lb. This truck is provided with six wheels. Load platform is 11 in. high in the low position, and the lift is 6 in. This is sufficient for skid-platform leg clearance when clearing door sills or other obstruction. The load platform is elevated by a triple-reduction, spur-gear power unit through sprockets and roller chains. An automatic cutoff switch limits the platform travel in either direction. The safety interlocking controller is so arranged that the controller must always be returned to the neutral position and the brake released to obtain traveling power. Special lengths and widths of platforms can be supplied, as well as many specialized attachments and handling devices.



"American" Bell-Type Retort Furnace

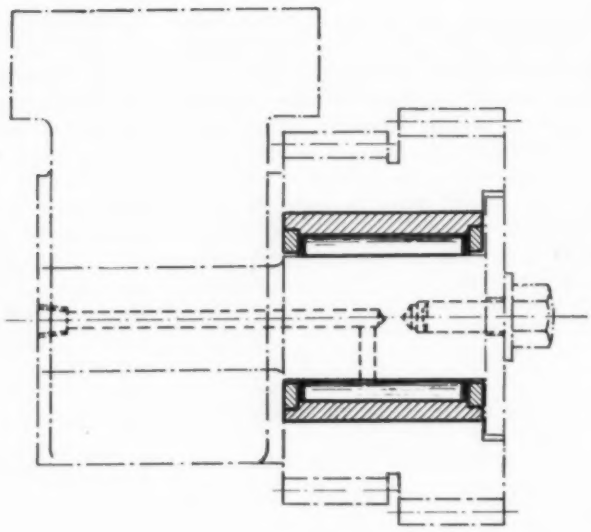
A bell-type retort furnace, developed by the American Gas Furnance Co., Elizabeth, N. J., is adapted for carburizing, nitriding, and for use with hydrocarbon gas for carburizing, ammonia for nitriding, or a neutral or inert gas for bright annealing. Equipment can also be used for hardening, normalizing, annealing and tempering. The bells are not necessarily cylindrical in shape, but may take some other shape if better adapted to the particular work. Uniform results are obtained because the retort is entirely inclosed in the furnace. In the case of carburizing, the spent carburizing gases escape from the bottom of the bell and are consumed in the furnace, thus increasing the efficiency. Furthermore, radiation losses are low because the bell is entirely inclosed by the furnace. Where comparatively slow cooling is satisfactory, the bell with its base and work may be removed from the furnace and air-cooled, or placed in a pit or in an insulated shop for relatively slow cooling.

Small sizes of this furnace are available and they may be quickly heated to temperature and various heat-treatments may then be performed successfully with minimum delay. It is necessary only to have two or three spare bells with bases available to permit carburizing and then hardening followed by tempering. In annealing, to obtain a full anneal, work may be allowed to remain overnight in the furnace after it has been shut down. This also applies to carburizing, should it be desired to obtain the maximum diffusion and graduation of case to the core. Extra bells are supplied according to the nature of the requirement so that the furnace can be maintained in production all the time. The furnace is provided with automatic temperature control. A special feature is the flow meter for checking the flow of gas through the retort, and thus check the furnace efficiency.



Bantam Rollers for Bearings

The Bantam Ball Bearing Co., South Bend, Ind., has recently attained volume production on small rollers such as recently have found favor by automotive designers for use in universal joints and gear-sets. The company is now manufacturing these rollers in sizes ranging from 0.0625 in. diameter to 0.1880 in. diameter and with tolerances of ± 0.0001 in. to ± 0.0002 in. These rollers are used in such applications as universal joints, diesel engine piston pins and crankshafts, high-speed marine engines,



Application of Bantam Rollers as an anti-friction bearing for a high-speed printing press gear

printing presses, gears, pumps, transmissions, small rolling mills, high-speed drills and tools, automotive brakes, rocker arms and other installations with very limited space and where the operating conditions require large bearing capacity. Because of the rapid introduction of these small rollers in the automotive and industrial fields, standard sizes have not been developed and adopted. However, the company is now manufacturing the following list of sizes in volume production:

*0.0625 diameter x 0.625 long
0.0625 diameter x 0.656 long
0.0937 diameter x 0.484 long
*0.0937 diameter x 0.750 long
0.1250 diameter x 0.375 long
0.1250 diameter x 0.750 long
*0.1250 diameter x 0.875 long
*0.1870 diameter x 1.000 long
0.1880 diameter x 0.922 long
*Proposed standard sizes.

Campbell Wet Cutting-Off Machines

High-speed cutting-off machines have been developed by Andrew C. Campbell, Inc., Bridgeport, Conn. Examples of the hard materials which can be cut are hardened steel, tool steel, glass tubing, stainless steel and plastics. A rubber-bond abrasive wheel or disk $\frac{1}{16}$ in. thick does the cutting, and revolves at a speed of 1800 r.p.m. Wheel diameter is 16 in.

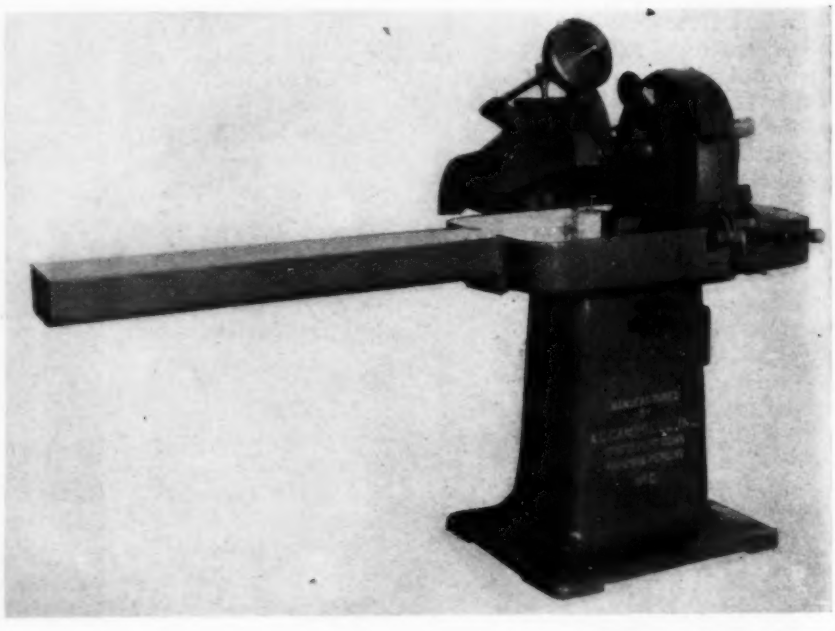
Burning of the work is eliminated by immersing it in coolant. Downard movement of the cutting-off wheel is controlled by two elements. Partial control is exercised by position of an adjustable counterweight and the remainder of the control is effected by means of an oil dashpot engaged by a plunger that moves downward with the arm of the machine during cutting. The rate at which the arm is lowered is controlled by an adjustable outlet orifice on the dashpot. An electric lamp lights when the cut is completed. A smooth, clean cut is secured. The two machines now available have capacities of 1 and 2 hp. Maximum diameter of stock taken is 3 in.

Century Electric Split-Phase Motors

The Century Electric Co., St. Louis, Mo., has recently added to its line split-phase motors in sizes from 1/60 to 1/3 hp. End brackets of these motors are of close-grained grey cast iron and are designed to protect the motors from falling objects, dust or dripping water. Frames are of rolled steel construction. Bearings are phosphor bronze. The company's wool-yarn system of lubrication assures one year's continuous operation.

Coffing Electric Hoist

An automatic balancing hinged hook and spring are featured in the electric hoist developed by the Coffing Hoist Co., Danville, Ill. This avoids a heavy counterbalance, and the balancing spring also acts as a cushion to prevent sudden or direct jerks when lifting a load. Several speeds of operation are available. In addition the hoist is light in weight. It has push button control, safety type limit switch, positive auto-



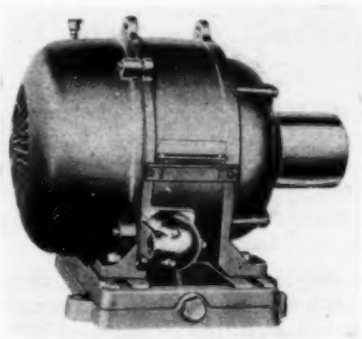
matic brake, oil-bath lubrication, special-steel drop-forged swivel hook, special alloy chain and spur gear drive. Capacities are ¼, ½, 1 and 2 tons. Lift is 8 ft. in all cases. The lifting speed ranges from 24 to 3 ft. per min., the latter for the largest hoist.

Whitney Press Brake

The Whitney Metal Tool Co., Rockford, Ill., states that its press brake operates just the reverse from other machines of its kind on the market. The stationary member is at the top, whereas the slide is below. Two coil springs balance the weight of the lower mechanism. The machine can be converted in from 10 to 15 minutes to a box or pan brake as well as a bending brake. A box finger at one end of the machine will make any desired pan or box within the limits of the machine by attaching various fingers to the platen. The stationary platen can be moved backward by means of screws so that the box fingers will be in the proper alignment with the bending apron. On either side of the machine are connecting links which are used to oscillate the lower bending rail. In these links are two stations, one to be used when the machine is an ordinary metal brake (upper station), and another when the machine is used as a box brake (lower station). The machine is built mainly of steel and takes care of thicknesses up to and including 16 gage.

Marble-Card Fan Seal Motors

Marble-Card Electric Co., Gladstone, Mich., has announced a line of fan seal type motors in sizes ranging from 2 hp. at 900 r.p.m., to 30 hp. at 1,800 r.p.m.



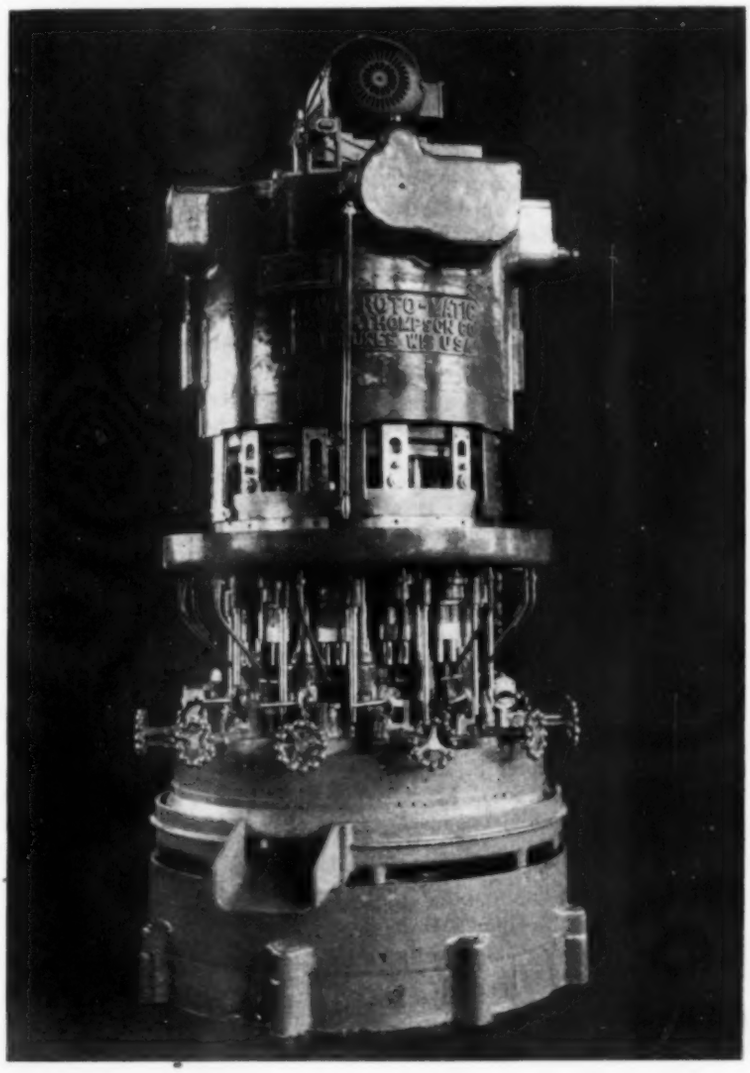
The motor is self-cooling, self-cleaning, self-protecting and entirely inclosed. It does not require a special motor housing or ventilating system.

Davis & Thompson "Rotomatic" Twelve-Spindle Vertical Continuous Drilling Machine

The standard 12-spindle vertical drilling machine has been adapted by the Davis & Thompson Co., 6619 W. Mitchell St., Milwaukee, Wis., for the use of two-spindle drill heads. There are twelve two-spindle drill heads and twelve milling spindles to take straddle mills for the purpose of milling the boss on the end of steering arm. There are also twelve fixtures arranged to grip the arm of the boss.

The fixtures oscillate. Movement of the fixtures is controlled by a cam under the table of the machine. This cam is stationary. The machine is continuous in its operation but it does not index.

Operation is as follows: The fixture is oscillated to correct position for loading. The piece is placed in the fixture and is clamped by the operator by a turn of the handwheel. As the machine turns around, the fixture carries the boss of the steering arm between the cutters. When the milling operation is completed, the piece is carried under the drill where it is held while being drilled. From this position it is carried under the reaming spindle where it is taper reamed. After these operations have been performed, the piece is carried to the loading position where it is removed and another piece placed in the fixture. Production with this method is approximately 600 pieces per hour. The machine is flexible and can be used for a wide range of work.



Continuous in operation, the "Rotomatic" Drilling Machine has twelve two-spindle drillheads and twelve milling spindles for drilling and straddle milling a boss on a steering arm

• PATENTS •

DECEMBER 27, 1932

Metal-Working Machinery

Work-Rotating Structure for Machine Tools. Herbert L. Flather, Nashua, N. H. Patent 1,891,923.

Welding Machine. Walter Ferris, Milwaukee, John P. Ferris, Whitefish Bay, and Glen Macomber, Waukesha, Wis., assigned to The Oilgear Company. Patent 1,892,208.

Machine Tool. Elmer E. Kelley, Windsor, Vt. Patent 1,892,239.

External Grinder. Clifford T. Raule, Brookline, Pa. Patent 1,892,364.

Wheel Dressing Mechanism. John Edgar, Rockford, Ill., assigned to Barber-Colman Co. Patent 1,892,388.

Centrifugal Casting Machine. Albrecht Von Frankenberg, Gelsenkirchen, Germany, assigned to Durafer Inc. Patent 1,892,440.

Apparatus for Centerless Grinding or Polishing. Rufus W. Fuller, Deerfield, Mass., assigned to Production Machine Co. Patent 1,892,453.

Tools and Attachments

Cutting Tool for Generating Non-Involute Gears and Gear Shaped Articles. Ernest Wildhaber, Brooklyn, N. Y. Patent 1,892,091.

JANUARY 3, 1933

Metal-Working Machinery

Machine Tool. Edward J. Kearney and Joseph B. Armitage, Wauwatosa, Wis., assigned to Kearney & Trecker Corp. Patent 1,892,894.

Metal Working Machine. Robert S. Brown, New Britain, Conn., assigned to The New Britain-Gridley Machine Co. Patent 1,892,929.

Gear Cutting Mechanism. Harold E. Stonebraker, Rochester, N. Y., assigned to Gleason Works. Patent 1,893,043.

Hydraulically Operated Cylindrical Grinding Machine. Carl G. Flygare, Worcester, Mass., assigned to Norton Co. Patent 1,893,076.

Lapping Machine. Herbert S. Indge and Sydney Player, Westboro, Mass., assigned to Norton Co. Patent 1,893,083.

Lapping or Grinding Machine. Charles H. Norton, Plainville, Conn., assigned to Norton Co. Patent 1,893,100.

Crank Shaft Lapping Machine. Arthur J. Strong, Detroit, Mich., assigned to Norton Co. Patent 1,893,111.

Tools and Attachments

Indicator Snap Gage. John N. Schneider, New Brunswick, N. J. Patent 1,892,969.

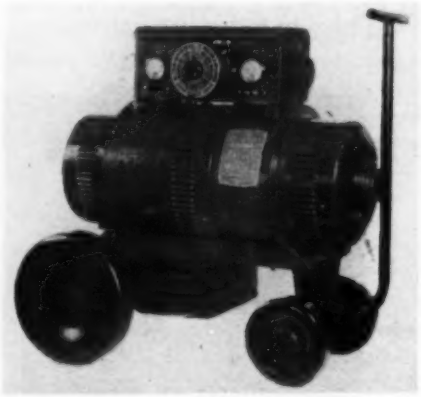
Control for Hydraulic Systems. Hans Ernst and Lester F. Nenninger, Cincinnati, Ohio, assigned to The Cincinnati Milling Machine Co. Patent 1,893,068.

Adjustable Reamer Grinding Clearance Gage. Joseph C. Friend, Ashtabula, Ohio. Patent 1,893,404.

Apparatus for Automatically Stopping Automatic Power Presses. Charles D. McDonald, Chicago, Ill., assigned to Continental Can Co., Inc. Patent 1,893,427.

Hobart Improved Arc Welder

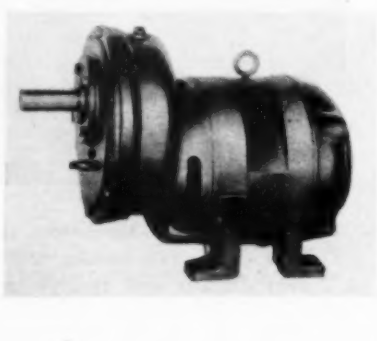
Sixty per cent more capacity is provided in the improved arc welder now placed on the market by Hobart Bros. Co., Troy, Ohio. The welder is fitted for handling both coated rods at 42 volts



and plain rods at 25 volts. It is easy to operate and the louvre construction makes it waterproof. The remote control permits the operator to weld a distance of from 50 to 100 ft. away from the welder.

James Motorized Speed Reducers

Motorized speed reducers from ½ to 20 hp. with a wide range of ratios and speeds are now built by the D. O. James Mfg. Co., 1114 W. Monroe St., Chicago, Ill. The gears are of the continuous-tooth herringbone type and are mounted on anti-friction bearings. The gears run in a bath of oil.



• TRADE PUBLICATIONS •

BEARINGS. Merriman Brothers, 185 Amory St., Jamaica Plain, Boston, Mass., has prepared Bulletin No. 33 on its "Lubrite" bushings and bearings of the self-lubricating type. Engineering data are given.

BEARINGS. "Better Bearings by Bower" is the title of a handsomely illustrated booklet being distributed by the Bower Roller Bearing Co., Detroit, Mich. From the pouring of the steel, the manufacturing operations and the inspection operations are treated in a pictorial manner and the various types of bearings made are illustrated.

FINISHING UNITS. The Paasch Airbrush Co., 1909 Diversey Parkway, Chicago, Ill., has published Bulletn F-12-32 on "Heavy Material Aircoating Units" showing equipment for applying heavy materials such as deadening compounds and heavy lubricants. Multi-color "Airbrushes," or paint spray guns, are illustrated in Bulletin G-12-32.

HEATING UNITS AND DEVICES. Publication GEA-1520A, issued by the General Electric Co., Schenectady, N. Y., is entitled "Electric Heating Units and Devices." In it are shown cartridge units, strip heaters, sheath-wire heating units, melting pots, soldering irons, industrial air heaters and control equipment.

PICKLING EQUIPMENT. The Haveg Corporation, Newark, .Del., has published a bulletin "Haveg Corrosion Resistant Chemical Equipment," showing applications of "Haveg," a German development now made in America. It is a plastic composed of asbestos mixed with an acid-resistant resin. Equipment uses of the material include the electrolytic processes, such as plating and pickling.

RUBBER MOUNTINGS. The Lord Manufacturing Co., Erie, Pa., has issued Bulletin 100 on bonded-rubber, shear-type mountings for the purpose of eliminating vibration in instruments, mechanical devices, machines and automobiles. Various types of mountings are shown, and specifications for some of them are given in detail.

SPRING-MAKING MACHINERY. Sleeper & Hartley, Inc., Worcester, Mass., has published a complete catalog of spring-making machinery, continuous wire-drawing equipment, wire-nail machinery and wire mill equipment. Each type of machine is described and specifications are listed.

American Machinist

February 15, 1933

Frame Deflection in Punch Presses

Not being able to find in reference books the information he desired on the relation between punch and die life and frame deflection, the author decided to make his own tests. These lasted six months and supplied some unusual data

ALBERT CLEMENTS

FOR SOME time it has been known that the deflection in a punch press frame during its working stroke was responsible for punch and die trouble. However, just what and how much of this trouble is caused by frame deformation has not been known because of the lack of test data.

Many toolmakers and tool designers when approached on this subject expressed surprise that the frame did deflect and pull the punch and die out of alignment. They thought the leader pins were all that was necessary to keep the punch and die perfectly aligned but readily assented to the fact that if the large punch press frame deflected under load the leader pins would deflect also. In some cases the punch actually hits the die because of misalignment caused by frame deflection. In most cases, however, the frame comes back to its natural position before the punch enters the die because the work material shears when the punch is only part way through it.

It was decided to study the effects of frame deflection using a job running in a punch press in our shop. A round piece, two inches in diameter with a square hole in the middle and six small perforated holes, blanked from 0.020-in. phosphor bronze was picked as suitable for any necessary tests. The shape of the blanking punch made it ideal for measuring wear on the punch at any point on its periphery. The parts were blanked two at a time in a compound punch and die. It was decided to devote all attention to the periphery of the blanked part and the punches and to neglect the perforated holes.

The punch and die were being run in a No. 21 Bliss inclinable C-type press. This press was rated as 13 tons in our shop. Our blanking and perforating job was 11 tons. We had two No. 21 Bliss presses which were exactly alike except that the frame of one was an iron casting and the other a steel casting. By running the same punch and die in two presses exactly alike except for their deflection under load, the performance of the punch and die under two different frame deflections could be observed.

The deflections of the two presses under a static load were measured. A hydraulic jack was placed between the bolster plate and the ram of the press and test indicators placed to note the deflection in the frame. The pressure of the jack was boosted up to 11 tons. Under this load the steel frame at the lower end of the rame deflected 0.003 in. vertically and 0.003 in. horizontally in relation to the bolster plate. The cast-iron frame deflected 0.010 in. vertically and 0.0045 in. horizontally under the same loading. The play in the slide and crank shaft bearings was measured and found to be about the same in both presses.

Using the punch and die picked for

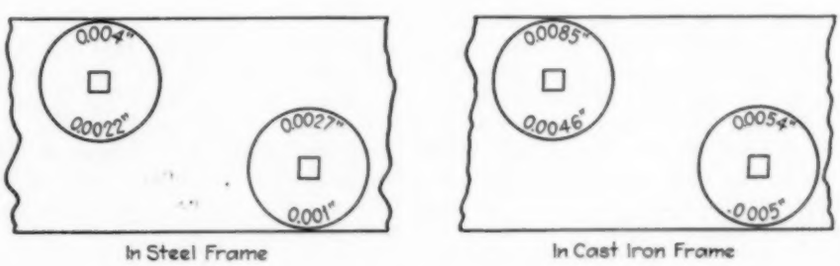


Fig. 1—Varying depths of punch penetration on work material show the effect of frame deflection

the test, punch impressions were made by having the punch shear only partly through the work material under power strokes of the press. The varying depth of peneration of the punches in both the steel and cast iron frame presses are shown in Fig. 1.

The punch and die were put in first class condition and run in the steel frame punch press until the burr on the piece part reached a height of 0.004 in. Then the tool was ground and a second run made in the cast-iron frame punch press. Six runs were thus made in the steel and cast-iron presses alternately, the punch and die being removed each time the burr on the periphery of the blanked part reached a height of 0.004 in. During these six runs, the following data were assembled.

At every 2,500 strokes during the six runs of the punch and die, a dozen parts from each die opening were taken and the height of the burr on the periphery was measured, using a micrometer. An average burr for the dozen blanked parts was taken at eight points on the periphery, and the results were recorded. The graph, Fig. 2, shows the maximum burr as recorded at every 2,500 strokes during one of the runs in the cast-iron frame press and one in the steel frame press. It can readily be seen that the burr on the piece during the run in the steel press took longer to form than it did during the run in the cast-iron press.

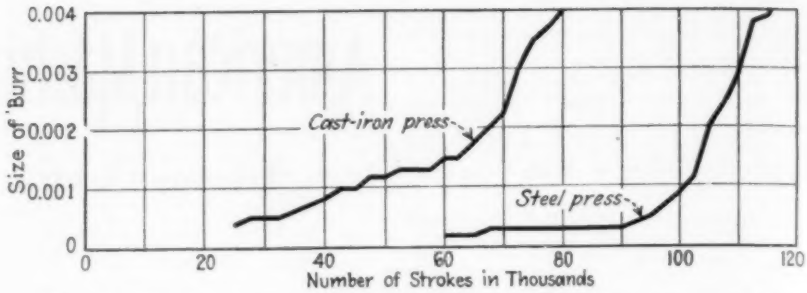


Fig. 2—Height of burr as related to number of strokes is compared for iron and steel frame presses

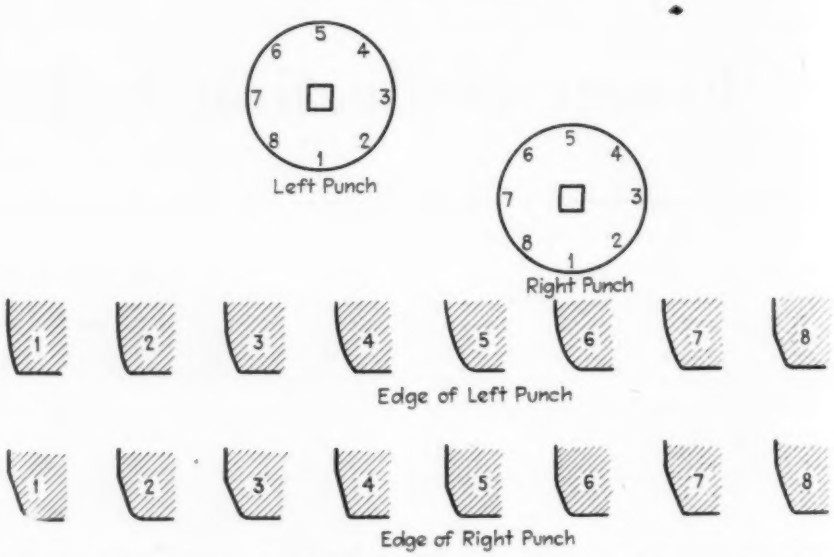


Fig. 3—Shadowgraphs disclose the nature of the wear on the punch edge

Longer Die Life

Many more parts were made in the steel frame press than in the cast-iron frame press before the punch and die had to be ground. The following number of strokes were made during the six runs before the burr reached a height of 0.004 in.: steel frame 135,000; cast-iron frame 70,000; steel frame 130,000; cast-iron frame 100,000; steel frame 115,000; cast-iron frame 80,000. The three runs in the steel frame press totaled 380,000 strokes; in the cast-iron frame press, 250,000 strokes. The length of runs in the steel frame were 50 per cent longer than those in the cast-iron frame.

After each run, before the punch and die were ground, the wear on the edges of the punches was measured at eight equally spaced points on the periphery of each punch. This was done in a shadowgraph machine which threw a shadow of the edge of the punch enlarged fifty times upon a paper where the outline of the punch edge was traced and then measured. Shadowgraph outlines of the edges of the punches after the fifth run in the steel frame press are shown in Fig. 3. The amount of maximum wear shown on the punches after each of the six runs was consistent, showing that the burr is largely caused by the wear on the punch and die. The graph, Fig. 4, shows the height of the burr around the periphery of the part compared with the axial and longitudinal wear on the corresponding punches. It will be seen that the largest burr is at the point of the greatest punch wear and the smallest burr at the point of the least punch wear.

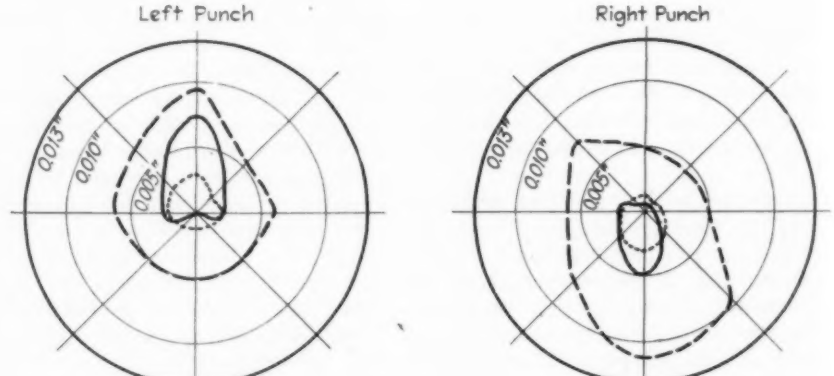


Fig. 4—Wear on punches is graphically compared to the size of the burr on the work

It will be noticed that the wear is the greatest at the back edge of the back punch and the front edge of the front punch. This is caused by a snap-through of the punch through the work material and by a greater abrasive action between the punch and the work material at these points. When the punch hits the work material, the punch press frame deflects, lifting the front edge of the punch from the work

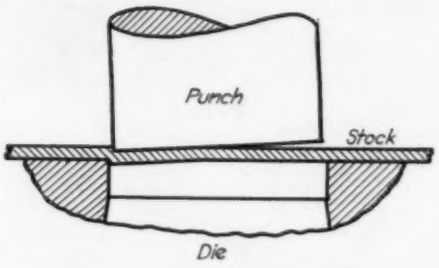


Fig. 5—Because of the frame deflection, the punch enters the work at an angle

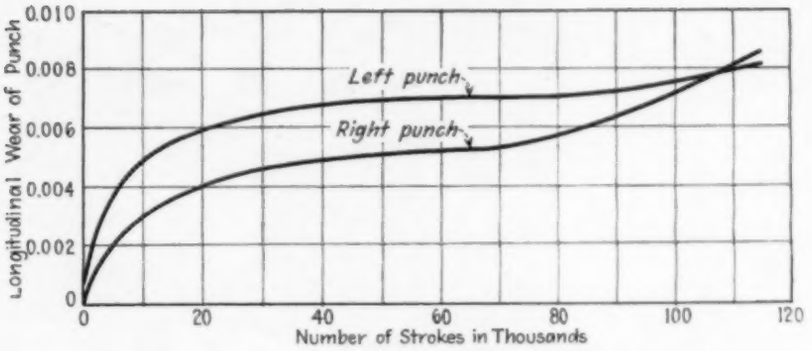


Fig. 6—The relation between wear and number of strokes is plotted for both punches

(Fig. 5). The back edge of the punch snaps through the work material, and as the ram continues downward, the sides of the punch cut as shears until the front edge of the punch cuts with a snap-through.

In our punch and die, where we have two blanking punches, they act as one punch in this respect because they overlap one another in a line from front to back of the tool. The punch entering the work at an angle causes our round punch to start shearing a hole that is out of round. After the piece part is sheared (in this case, when the punch is $\frac{1}{4}$ to $\frac{1}{3}$ of the way through the work material), the frame comes back to a normal position pulling the punch perpendicular to the work material. This gives a greater pressure between the punch and the scrap at the front and back of the punch.

This uneven wearing of the punch may be partly overcome by putting a shear angle on the punches when grinding them. For this punch and die, during a later test, the punches were ground so that the front of the front punch was 0.008 in. longer than the back of the back punch. This prevented extra wear on the punch caused by the snap-through. Using the tool with the punches ground in this way, a run of 125,000 strokes was made in the cast-iron frame press before the burr reached a height of 0.004 in. as compared to an average run of 85,000 strokes with the punches ground straight. The burr on the piece during this run formed not only at one point but over nearly its whole periphery.

During the fifth run (which was in the steel frame press) the punch edges were shadowgraphed after 10,000 strokes, 45,000 strokes, 75,000 strokes, 110,000 strokes and 115,000 strokes. The maximum longitudinal wear on the punches progressed as shown in Fig. 6. It will be seen that the maximum longitudinal wear at 10,000 strokes is about one-half of that at 115,000 strokes. While the punch edge is still sharp, the action between the punch edge and the work material, instead of being purely abrasion, is a breaking down of the edge caused by an overstressing resulting from poor support and probably also from minute cracks in the edge caused by the grinding operation used to sharpen the punch.

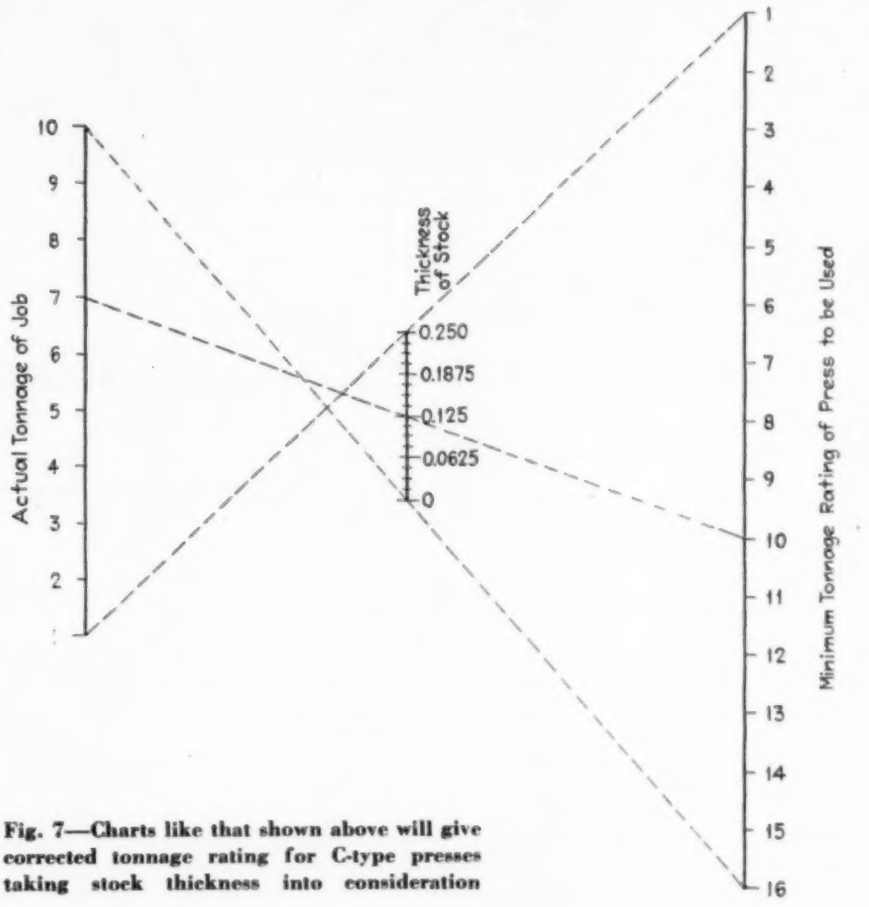


Fig. 7—Charts like that shown above will give corrected tonnage rating for C-type presses taking stock thickness into consideration

On expensive dies the output per life of the die could be materially increased by not grinding it to a knife edge whenever grinding was necessary but by grinding off only half this amount. This would decrease the number of parts per grind by about 10 per cent but would increase the number of possible grinds during the life of the tool 100 per cent.

From the foregoing observations the following conclusions are drawn. The C-type press with a steel frame is superior to that having a cast-iron frame. The method of specifying the proper presses for dies by tonnage only is wrong. If a small part is punched out of heavy stock, it may satisfactorily be done in a C-type press which comes under its tonnage rating. However, if the part being punched is large in area and of thin stock it would need a C-type press of a tonnage quite a bit larger than the actual tonnage of the job in order to get a press that is stiff enough to perform satisfactorily. Jobs should be assigned to presses using a chart similar to that in Fig. 7. Where possible straight-sided presses should be used on frail dies or dies which blank out large pieces.

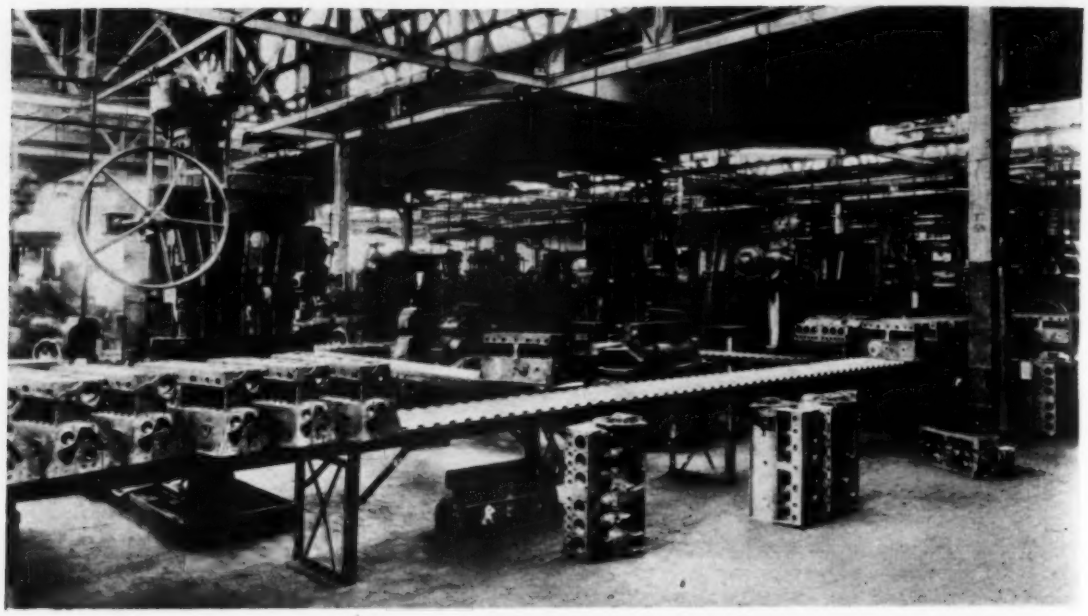


Fig. 1—Gravity roller conveyor handling motor blocks in large machine shop

Shop Applications of Simple Handling Units

E. J. TOURNIER

THE SEARCH for ways to cut costs in machine shops and other metal working establishments should not be limited to the adjustment of wages and overhead. Rather are they to be found in lessening the cost of manufacturing per unit of product. In most cases, reducing the cost of machining and handling lessens the unit cost, since in quantity production at least, handling is a large part of the work.

Mention of mechanical handling equipment need not imply elaborate conveyor systems, because simple and inexpensive units are available, if knowledge of their application is also present. And in this case, knowing what to use and where to use it is more important than familiarity with general applications of certain types of equipment to more or less similar materials. What is of real value is the positive knowledge that a conveyor or what not will do some specific thing better than something else, even though it was not designed for the special purpose.

The fact that in any industry "everybody uses conveyors" may be true of large plants where processes have been standardized, perhaps by the use of a conveyor assembly line. But the smaller plants are not usually so well informed, and in none of them, large or small, is it generally known how many unfamiliar uses there are for materials handling equipment.

To take a familiar type of conveyor, it is well known that gravity rollers were first designed to handle boxes. But for handling flexible bags of cement, the rollers do not at first appear as a solution of the problem. Yet a contractor used them to bridge a 30-ft. gap between a box car and a building. He set up a gravity roller conveyor at the car door, and placed flat boards on the rollers on which the bags were easily carried to the building. The same thought solved the problem of a pump manufacturer in Iowa. In this case pistons were transferred 50 ft. from the machine shop to the assembly room, with boards placed on the roller conveyor.

Once it is demonstrated that a given type of equipment is suitable for certain classes of work, its use gradually extends to other applications. As an example of this is a gravity roller installation at the plant of the Oakland Motor Co., at Pontiac, Mich., handling motor block castings. Although more elaborate than the piston conveyor, the Pontiac system operates on the same principle. This installation consists of a series of short conveyors serving boring mills and gang drills machining cylinder blocks. Each of the short units is arranged to discharge onto one long line of gravity rollers at right angles to the others, from which it collects. As each operation is completed on the machines the castings are laid with their flat surfaces on the rollers, and move by gravity to the collecting conveyor. Savings in this case cannot be computed because operations were laid out around the conveyor system, but the use of conveyors here made possible a continuous process of manufacture.

In other situations where the need is for rapid preparation of tools rather than for continuous handling of parts, equally simple equipment may be used. For example, the power lift-truck, although originally designed for piling goods, is frequently used by millwrights, pipefitters and electricians in maintenance work, and even for erecting structural steel.

A power conveyor in the Packard

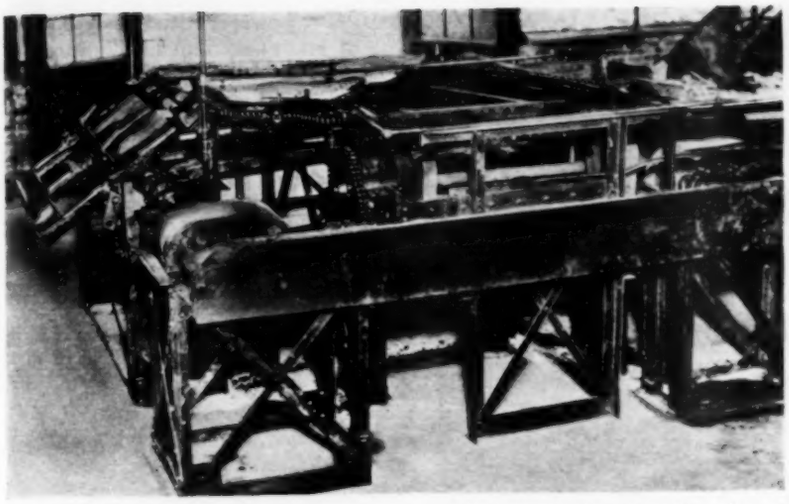


Fig. 2—Discharge end of conveyor used in continuous heating of forgings. Conveyor saves 40 per cent of former handling cost

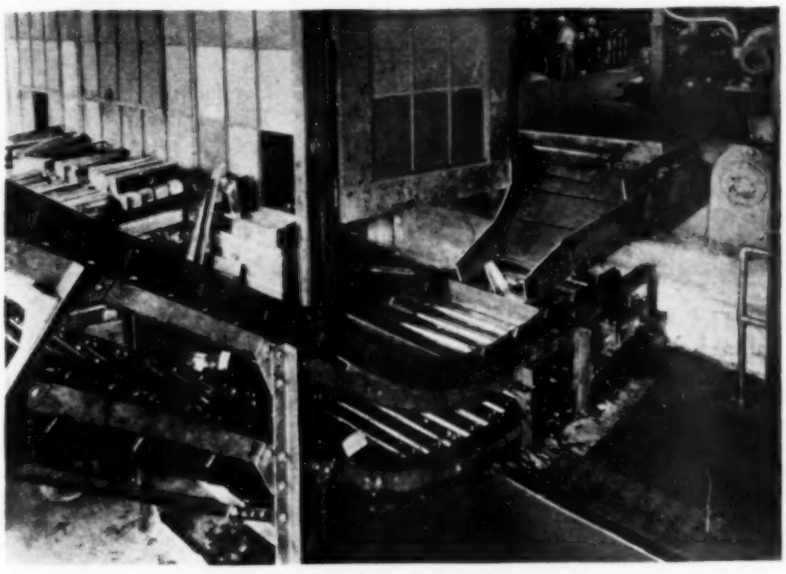


Fig. 3—Loading end of steel apron conveyor taking steel scrap from press room to cars. Investment returned in two years

plant at Detroit illustrates another instance of the unusual use of familiar equipment. In this case a chain conveyor of the type generally associated with progressive assembly work, serves an entirely different purpose. It is used to convert a series of intermittent heating processes into a continuous one, with marked economies.

In the heat treating department two furnaces are used for annealing front axles, steering knuckles, etc. The ovens are placed in line some distance apart so that forgings may be passed from one to the other if two heats are required, or if necessary the second furnace may be by-passed when only one heat is needed.

Essentially the system consists of a double strand conveyor bringing forgings to the first furnace; a cooling conveyor between furnaces, and a second double strand conveyor at the discharge end of the second furnace. Alongside of both ovens a single strand chain connects the feed and discharge conveyors.

The two double strand conveyors are used with heat resisting alloy trays, or grates with wide openings, fitted with round lugs at each corner. The lugs engage attachments on the chains by which they are pushed, the grates lying flat on steel tracks. In this position at the loading point, the trays are loaded by hand with forgings. The conveyor then carries the loaded grates to the first furnace, and the trays are automatically released from the chains. A mechanism which is part of the furnace now pushes both trays and forgings into the heat chamber, then through to the end of the second furnace. Here the grates are turned over mechanically, so that they fall on edge into a trough containing the single strand chain, which returns them to the starting point.

Timing of the various operations requires synchronizing of conveyor speed with the furnace temperature control, the speed regulation being accomplished by means of variable speed transmissions.

By this unusual conveyor application operations were made continuous, thereby increasing production 50 per cent and reducing handling costs 40 per cent.

The Detroit body works of the Chevrolet Motor Co. offers further evidence of conveyor versatility, exemplified by an apron conveyor handling steel scrap. This type of equipment, first used as a feeder under a coal hopper, can be adapted to other uses if properly modified. In the present case it was not an inevitable sequence that because apron conveyors handle coal they will handle anything. Material such as small bolts lodging in pan joints would soon make the conveyor unworkable. Small scrap would have the same result, and it was therefore necessary to have a specially designed pan for the service in question.

From Coal to Scrap

The conveyor transfers steel scrap from a point just inside the press room to railroad cars. Near the inner wall a collecting hopper is set flush with the floor and discharges directly into the conveyor below. The latter is level for a short distance, rises at an angle of 34 deg., after which it is again level for a distance of 5 ft. The conveyor then discharges into cars on two tracks located about 30 ft. from the building wall.

Essentially the conveyor consists of two parallel strands of steel roller chain which carry between them a series of special overlapping steel pans forming a continuous articulated apron. At the loading point skirt boards are provided to prevent material spilling over the sides of the pans. The entire machine is supported on a structural steel truss frame extending from the building out to the tracks. The chains of the conveyor are supported on four braced angles which are part of the structure and serve as tracks. At the discharge end the apron extends half-way between the tracks in order to load cars on either side through a pair of swinging chutes. These may be lifted to clear the tracks when not in use.

This installation, while accomplishing its purpose of keeping the press room clear, also made sufficient savings to pay for itself in two years.

The examples of well-known types of materials handling equipment cited here were selected because they illustrate the point that standard equipment with proper selection and modification will perform unfamiliar services.

Car Wheeling Up to Date

A. T. KUEHNER
The Niles Tool Works Company

A study of railroad car wheel shops indicates a lucrative field for savings in mechanical operation

OF LATE YEARS, the evolution of wheel repairs toward precision standards has been rapid, but unfortunately, the same attention has not been given shop conditions. Unfit machinery and poorly arranged shops are being forced to meet high standards; they cannot economically serve the purpose.

When planning facilities of this kind, a detailed study should be made of the entire sequence of operations as a basis for a shop layout adequate to produce the desired output at low cost. This will permit proper storage space and equipment details to be provided between machines. Set rules cannot be specified to attain this condition, but a review of modern machinery, equipment details and well planned shops may give those interested in plant rehabilitation suitable answers to their particular problems.

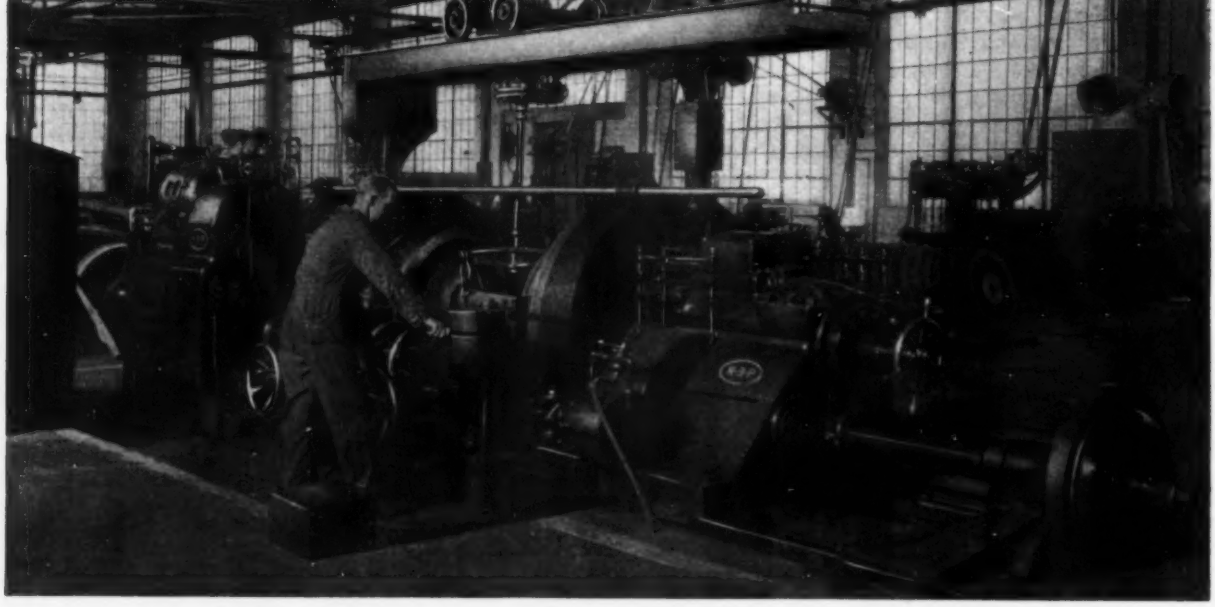
The handling of repairs to wheel sets can be divided into two classes: those requiring running repairs, only, such as wheel tread turning or journal reconditioning; and those requiring a general reconditioning, such as wheel or axle renewals. Frequently, one class is considered without the other, but in most instances, they are combined as one unit. Each class, however, demands a specific type of machinery and handling equipment, and when treating them as a unit, their respective areas should be localized.

Wheel repair shops are of three distinct types, designated according to the unloading and loading track elevation in relation to the height of the building floor:

1. In the depressed track type, the height of either the box car or flat car is even with the level of the ground, and the wheels and wheel sets are rolled to and from the cars, eliminating all mechanical handling means. The depressed tracks should be arranged, both as to location, number and length, to suit conditions. Objections are sometimes made to this type of shop because the depressed tracks, being considered open pits, naturally add to the difficulty of safety observance and create a higher cost of maintenance, particularly so if they are improperly drained. Further, depressed tracks are far from ideal in the movement or handling of empty or loaded cars. They demand a systematic switching service if a production schedule is to be maintained.

2. The type where the building and platform are raised to a height even with the floor of the car immediately suggests an expensive installation. Such a layout, however, possesses an attractive operating condition in that, with the tracks properly arranged to take care of both the mounted and unmounted wheels, power crane facilities are not required nor are the evils of the depressed track type present.

3. The type most universally used is where the tracks, platform and building floor are ground height and handling



Ease of loading and unloading is dependent on proper installation of the car wheel lathe

means of the self-contained propelling type is provided for unloading and loading wheel sets and all other parts. Because of its flexibility, this arrangement gives the most satisfactory results.

The detail layout of the shop will be entirely dependent upon the wheel renewals necessary in the territory the shop is to serve with further consideration given to possible future expansion. This having been determined, the proper type and number of machine tools must be selected to meet the requirement. This selection of machine tools need not be an assumption, for all machines entering into wheel repairs have a definite output. Tools selected should be arranged in proper relation to each other with ample working clearance for the operator and suitable handling and storage facilities interposed to avoid hold-ups of the work scheduled.

Wheel Shop Requirements

The full machine requirements for a modern wheel repair shop is as follows:

Power press, either one or two, for demounting and mounting wheels,
Axle lathes for finish turning,
Axle burnishing lathes,
Car wheel borers for boring the wheel axle fit,
Car wheel lathe for tire turning,
Combination journal and axle lathe for reconditioning the journals of mounted wheels,
Emery wheel of conventional type for tool grinding.

Production machines have been redesigned in recent years, to meet changed standards, and many refinements have been added to permit an increase in output. A brief description of each and their production follows:

Car wheel presses are built up to 600 tons pressure in both single- and double-end types. The double-end press is at a disadvantage in all but production, and reference to the figures following reveals an increase in the number of man-hours to obtain this higher production. An analysis should be made of this one item, as it determines the type and number of presses required and their arrangement in the shop for best results.

Single or Double-end?

If the contemplated production is of sufficient volume to suggest a double-end press, the following points should be considered before a definite decision is made to purchase it: first, whether its use as a general-purpose tool provides as flexible and convenient a layout as when two single-end presses are used, one for demounting, and the other for mounting, each located in the most strategic position. Second, the double-end press does not lend itself to a straight-line movement in the mounting operation, for the wheels after being mounted cannot be rolled through it, resulting in a reverse move. This straight-line movement is obtainable with a single-end press when equipped with rolling through attachment. Third, the double-end press must be rearranged each time the wheel operation is changed from demounting to mounting and vice versa, which would not be the case if individual presses were used, each permanently arranged for a specific operation. Fourth, it must be of a tonnage capacity equivalent to the stripping requirement which is at least 50 per cent higher than required for mounting. For a replacement program, these points may not be objectionable enough to prevent a purchase of the double-end press, but in a new shop, they should be given consideration in view of the fact that two single-end presses can be obtained for a cost equivalent to that of one double press.

All presses should be equipped with a hydraulograph, an attachment that provides a permanent charted record of the variation in pressures required for the mounting of each wheel. It enables the operator to visualize the entire progressive mounting pressure, so essential to meet present-day precision requirements for wheel mounting. It provides a still further check, in that the work of the press operator can be reviewed daily by having the shop foreman inspect the chart. The penalities from wheel failures, due to bad wheel fits, are entirely too severe to permit chance taking when the hydraulograph so readily discloses defective mounting.

Wheel Press Production

Good hourly production obtainable from wheel presses is as follows:

Single-end type:		
Demounting	3 men	18 pair
Mounting	3 men	13 pair
Double-end type:		
Demounting	4 men	25 pair
Mounting	4 men	20 pair

Axle lathes are built in two sizes, a standard pattern and heavy pattern. The standard pattern machine is generally used for turning only, the burnishing being done on a straight burnishing lathe.

This method of finishing the axle introduces a two-fold handling operation, to which mechanical superintendents often object. On the heavy axle lathe, this is not necessary, as the machine is so constructed that it permits the axle to be turned and burnished at one setting. These two operations differ so widely as to their requirements that it seems the wiser plan to segregate them even though it does call for rehandling the axle.

The turning operation demands that the machine be accurately maintained, and under this operation, not a severe one, accuracy can be expected. The burnishing operation, on the contrary, does not require machine accuracy but machine rigidity to withstand the severe strain on the bed-ways and centers tending to destroy its alignment. The axle lathe cannot be properly arranged to neutralize fully the severe burnishing strains. Therefore, the burnishing should be done on another machine. This will result not only in the production of better work but will also provide a decided increase in production.

Every axle lathe should be equipped with a full compensating type of driving head which not only expedites loading and unloading through a quick-acting set of driver dogs, but because the head-driven spindle is spherical in shape, permits this driving member to adjust itself to any misalignment of the axle, insuring a concentrically turned journal and wheel fit.

Turning and Burnishing

The burnishing lathe is a single-purpose tool, used for burnishing only and arranged with many modern refinements that expedite handling the axle. Good eight-hour production of 5x9-in. journals obtainable from this equipment is as follows:

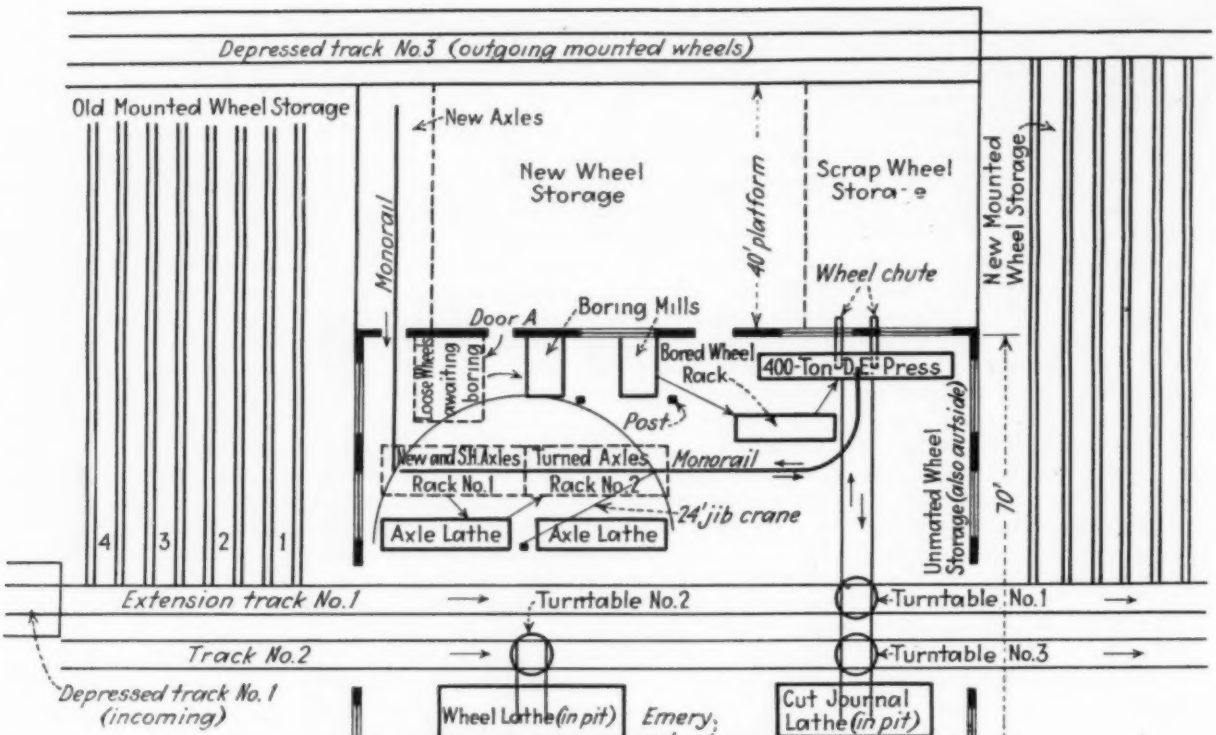
16 axle wheel fits and journals reconditioned on the heavy axle lathe,

24 axle wheel fits and journals, turned only, on the light lathe,

75 axle journals, burnished only, on the burnishing lathe.

Car wheel borers are made in two sizes, a 42-in. light pattern and 48-in. heavy pattern. The light pattern machine is used in municipal railway shops where production is not a vital factor. It is a plain tool devoid of the production features found on the heavy car wheel borer. The heavy pattern is a real production machine built to withstand severe service. It is equipped with a novel type of crane, for ease and convenience of loading and unloading wheels, and has a table arranged with a self-centering automatic quick-acting chuck. Power traverse to the boring bar as well as a table brake, if applied, tends to increase production. The heavy machine can be equipped with an attachment known as a hub facer, and where facing of the hub is to be done, the machine must be so arranged at the time it is built.

Good eight-hour production of 5x9-in. wheels obtainable from this equipment,



Storage space, track and crane facilities are important considerations in car wheel shop layout

where the operator obtains the boring sizes, is as follows:

30 cast iron wheels finished bored on the 42-in. machine,

90 cast iron wheels finished bored on the 48-in. machine,

40 steel wheels finished bored on the 48-in. machine,

105 cast iron wheels finished bored on the 48-in. machine, arranged with the wheel handler.

Car wheel lathes are furnished in various sizes to suit specific work, namely:

No. 1 size, 42-in. capacity, for municipal railway repair shops; this is not a production machine.

No. 2 size, 42-in. capacity, for municipal railway repair shops where production is desired and for railroad repair shops at outlying points where maximum production is not essential.

No. 4 size, 52-in. capacity, for railroad repair shops where a continuous maximum production is expected.

These machines are equipped either with pneumatic or electric hoists for handling the wheels to and from the centers. The No. 1 and No. 2 lathes, in addition to turning tires, have an added advantage in that they are basically designed to receive attachments for turning both the inside and outside journals of car wheel sets, an attractive feature if the lathe is to be made a general purpose tool.

The No. 4 machine has a broader application than for turning tires on car wheel sets only; it is arranged as a standard design to turn the general run of trailer wheels, and where the machine is installed in or near the locomotive repair shop, it can be used to relieve the driving wheel lathe of such work. This lathe can also be arranged with special face-plates, permitting it to turn the smaller yard engine class of driver wheels, which face-plate arrangement does not impair its usefulness on the standard run of car wheels. Since the advent of anti-friction bearings on cars and locomotives, railroads using such equipment must see that future lathes purchased are so arranged that wheel sets, equipped with anti-friction bearings, can be handled in the machine with the least possible delay in conversion from one wheel set-up to the other.

When installing car wheel lathes, consideration must be given to their proper position in the shop, particularly with respect to the storage and roll-in track, enabling wheel sets to be handled back and forth with the least possible effort and delay. The illustration shows a well installed machine. The foundation for and erection of these lathes should be in every detail as designated by the builders, for they have given this item careful study, resulting in notations on their foundation plans that must be adhered to, if satisfactory operating results are to be obtained.

Where all factors that enter into wheel lathe production are of the best, the average eight-hour production of 36-in. wheel sets obtainable from these machines is as follows:

No. 1 lathe	6 pairs,
No. 2 lathe	10 pairs,
No. 4 lathe	18 pairs.

The combination journal turning and axle lathe is furnished in a 45-in. size only. The title term "combination" signifies that the machine can be used either as a straight axle lathe or a journal turning lathe. Two carriages are provided as standard equipment suitable for outside journal turning only, and a third carriage can be applied to recondition inside journals and face-off hub liners.

The production from this machine is entirely dependent upon the manner of its installation. It can be erected either on the floor, in which position it requires hoisting means to handle the wheel-set to and from the machine, or it can be installed in a pit at a height where the wheel-set can be readily rolled to and from it. The pit installation eliminates the need for raising and lowering the wheel set and balancing it to enter the centers; as a consequence, production is materially increased. Though the pit method represents a higher installation cost, it is soon offset by the increase in production obtainable.

Good eight-hour production of 5x9-in. wheel sets obtainable from the 45-in.

machine, turning and burnishing both journals, is as follows:

20 sets.....floor installation,
28 sets.....pit installation.

The accompanying layout is a ground height shop with two single depressed tracks, one assigned to unloading and the other to loading. This shop is designed for straight-line operation, with one 400-ton double-end press to handle both the demounting and mounting operations. The wheels to be stripped are unloaded from flat cars on depressed track No. 1 or taken from the old mounted wheel storage area and rolled into the shop to turntable No. 1 and rolled into the press. The stripped wheels are rolled through an opening in the wall to the storage area, awaiting loading.

The axles are picked up by the monorail crane and stored on rack No. 1, awaiting reconditioning. They are handled in and out of the axle lathes with a jib crane, and after being reconditioned are stored on rack No. 2, awaiting wheels. The new axles to be finished are brought into the shop, and stored on rack No. 1 by a monorail crane.

Wheel Handling

The new wheels to be bored are rolled into the shop through Door A and stored near the boring mill. After being bored, they are rolled into the individual bored wheel storage rack located close to the press. The axles are brought to the wheel press by the monorail crane and held suspended in the press while the wheels are rolled onto the trucks preparatory to mounting. After being mounted, they are returned to turntable No. 1, there turned, and rolled out of the building to the storage area for loading. The loading is done on depressed track No. 3, which is of sufficient length to take care of three cars if desired.

Wheels requiring tread and axle reconditioning, are rolled into the shop on track No. 2 to turntable No. 2 to be placed in the wheel lathe if tread turning is required, and to turntable No. 3 to be placed in the journal turning lathe if journal turning is required. After reconditioning, they are rolled out of the building on this same track to the mounted wheel storage area for loading.

This shop was designed for a contemplated daily eight-hour output of 30 mounted cast iron wheel sets, using both old and new axles, and 18 reconditioned wheel sets with an operating force of:

1 shop foreman,
2 operators—axle lathes,
1 operator—car wheel borer,
1 operator—press, and loading and unloading of wheel from cars,
1 operator—car wheel lathe, journal lathe,
4 helpers.

Modern Motor Methods

III. Pistons

FRED H. COLVIN
Editor, American Machinist

BOTH aluminum and cast-iron pistons are covered by this study as is indicated by the difference in operations. Cast-iron pistons are received in an annealed condition and are usually annealed again before the final finishing operations. The second annealing relieves the stresses set up by the removal of the skin, or outer surfaces of the castings, and by the heavy cutting stresses of the roughing operations. A list of the general operations follow:

Rough bore and face open end,
Drill piston pin hole,
Rough turn O.D. and face top,
Finish turn O.D. and face top,
Reface open end,
Finish piston pin hole,
Press in bushings, if used,
Drill oil and smoke holes,
Grind top and O.D.,
Grind side relief, if used,
Inspect, sort and stamp.

The initial operation is similar in different plants. With the piston held in a chuck, the open end is bored and faced in nearly all cases. This seems to have replaced the method which first centered the top or solid end, drove the piston by a forked driver against the piston pin bosses and rough turned the outside and face. In some cases a hook tool reached in to the open end and bored and faced that end during the first operation.

Great care is now given to the boring and facing of the open end as this is now used to center the casting for further operations and also to hold it square. Driving is still done by a forked center inside the piston after the open end is bored. Nearly all piston shops now ream or rebore the open end and reface it. In one case, the chamfer that acts as a center for the finishing operations is ground. These operations on the open end are listed in Table I.

The head or closed end of the piston also receives careful attention as this directly affects the compression of the engine, which is a much more important factor than formerly. Where pistons are finished by grinding between centers, the accuracy of the center holes is important. For this reason we find two shops that recenter the piston. one as late as the eleventh operation, or just before finish turning the ring grooves. The accuracy of the ring grooves is also another reason for the recentering after the rough turning operations.

It will be noted that two or more operations are sometimes combined, as can be seen where the same number appears in more than one place in the same column. Thus in Table I the open end is rough bored, faced and also chamfered in operation 1, Column *D*, and in Table II, the boss on the end is cut off at the same time the face is finished in Operation 7, Column *B* and in Operation 9, Column *C*. In some shops the closed end is finished by turning or facing, while in others the final finish is given on a grinder, usually with a circular table.

Table III gives the major operations on the skirt, which includes the piston-pin holes, oil and smoke holes, and ring grooves. This shows a general picture of the operations, grouped according to

TABLE I
Operations on Open End of Piston

	Sequence of Operations			
	A	B	C	D
Rough bore and face	1	1	1	1
Rebore or ream	4	..	5	3
Chamfer or center	6	4	13	1
Reface	7	..	..	3
Recenter	14	12	..	8

TABLE II
Operations on Closed End, or Head of Piston

	Sequence of Operations			
	A	B	C	D
Rough face	3	2	2	2
Center	5	1	1	1
Recenter	..	..	11	3
Cut-off boss, or center	17	7	9	14
Finish face or grind	5	7	9	17

the part of the piston being worked upon. The piston-pin (or wrist-pin) hole operations are grouped together, although there is, of course, quite a gap between the rough boring and the final finishing. The first maker, for example, rough drills in Operation 2, reams in Operation 8 and line reams in 11. The second rough and finish turns the outside before drilling the pin hole in Operation 8, rough and finish turns the ring grooves and drills all holes before reaming the pin holes. But when he again starts work on the holes, he reams twice and burnishes in successive operations. In all the other cases, however, there is a gap of several operations between the

TABLE III
Operations in Skirt of Piston

	Sequence of Operations			
	A	B	C	D
Drill piston pin hole	2	8	4	4
First ream pin hole	8	18	10	10
Line ream pin hole	11	19	18	20
Burnish or hone pin hole	...	20	...	21
Press in bushing	12	...	...	...
Line ream bushing	16	...	...	...
Rough turn O.D	3	2	2	2
Finish turn O.D	5	5	6	5
Grind O.D	15–19	6–13	15–16–17	7–9–13
Grind ring lands	24	11	15	...
Grind side relief	18	...	...	15
Rough turn ring grooves	21	2	2	5
Finish turn ring grooves	21	14–15	14	5
Burnish turn ring grooves	...	...	...	22
Saw cross slots	...	3	8	...
Saw long slots	...	10	12	...
Drill oil holes	13	9	3	...
Drill smoke holes	22–23	16–17	7	8
Inspect, sort, stamp	20	23	19	23

first and final reaming, although in *D*, the burnishing or honing follows the line reaming.

The outside of the piston is rough turned early in the sequence of operations in all cases, never later than the third. The first operation in all these shops is inspection or sand-blasting. Finish turning follows fairly closely. Practice varies widely as to the machining of the ring grooves, however. In two shops the ring grooves are roughed out at the same time as the outside, while in another they are not cut until Operation 21, being roughed and finished at the same time. In *B* and *C* they are roughed at the same time the outside is rough turned and finished in Operation 14. Maker *B* also gives a second finishing cut, and *D* burnishes the grooves as a final operation.

Grinding has become a standard method of finishing the outside. Two makers use two grinding operations and the other two use three though at varying sequence, from the sixth to the nineteen operation.

Side relief, at the ends of the piston pin bosses, is usually confined to cast-iron pistons, this relief being cast in the case of die-cast aluminum pistons. The saw slots, to allow for expansion, are usually confined to aluminum pistons.

Oil holes refer to the piston pin boss and indicate that the pin is either held in the rod or floats in both rod and piston. Where the piston pin is locked in the piston, no oil holes are required. Smoke holes, through which excess oil from the cylinder rolls escapes after being removed by the scraper rings, vary widely in number and their operation sequence. Two makers drill them all in one operation, while the other two either split the operation or drill holes in two ring grooves.

Sticklers for standardized operations might point to the variation in the sequence of operation as a horrible example of chaotic methods. But practical men, who are familiar with various plants, and who have watched them develop through the years, will not be seriously disturbed. Whether the different sequences are caused by varying machine equipment or by the individuality of the men in charge is not important, assuming that the results are satisfactory in each case. And the fact that each of these four companies has many thousands of pistons in daily operation makes this a safe assumption.

It is the aim of each builder to produce pistons that are true as to concentricity and squareness of the piston pin hole, and freedom from distortion. This aim is behind the selection of the methods used in each case. It is to remove all distortion that the open end is rebored and refaced at various times during the process, and that several grinding and grooving operations will be found in nearly all cases. Results indicate that perfectly satisfactory pistons can be produced by any of the methods shown, which strengthens the belief that there is no royal road to success.

Abrasive in Cylinder Walls
Discussion

C. G. WILLIAMS
Consulting Mechanical Engineer

John R. Godfrey (*AM*—Vol. 76, page 408) reopens the above much-mooted question. Regardless of tests made by the Norton Company and the U. S. Bureau of Standards, some doubting Thomas will occasionally resurrect it. The same point of view is still retained by many railroad shopmen, foremen, superintendents, even superintendents of motive power, and there seems to be a new crop of the credulous every few months. The cry of abrasive retained by the ground surface of cast iron and steel has kept many grinding machines out of railroad shops. Only last year a manufacturer of pumps said, "We never grind our pump barrels because of the abrasive that is retained in the cast iron."

During the period when the use of grinders was growing most rapidly, that is during the World War, the Norton Company carried on many tests to determine if any abrasive could be retained in the walls of cylinders or on the faces of surface-ground cast iron plates. About the same time, the U. S. Bureau of Standards proved that no abrasive could be retained by the cast iron. After these tests had become known, the contention died out in all but the backward railroad shops.

In 1928 I entered the controversy. I made some 400 examinations of steel, semi-steel, gray iron cylinders, high-test cast iron cylinders, liners for oil-well pumps and many types of automobile cylinders, both in the home shop and in those automobile plants which were using honing machines. I also examined water pump barrels, airplane motor cylinders, locomotive and railroad car airbrake cylinders and air compressor cylinders, both simple and compound, and a 15x54-in. diesel engine cylinder.

After that, I tried to get two railroads to install portable hones in their shops to finish the cylinders of locomotives and to recondition them before inserting new piston rings. Here I ran into the old fetish. One shop had a small internal grinder in the toolroom. In order to convince the master mechanic, ten small cast-iron cylinders were ground dry. The material removed, which of course contained abrasive grains, was saved. Samples of this material were examined with a microscope, then acted upon by acid that would not affect the abrasive grains but would remove the particles of cast iron. The cast iron particles were burnt out of other samples with a Bunsen burner. This was done to enable those interested to note the condition and amount of abrasive grains. Then the cylinders were bored out, approximately 0.012 in. of metal being removed. The metal was examined in the same way. Not a particle of abrasive was found. The cylinders were again ground out, split by power saw, and examined with a microscope. After four halves had been examined, the master mechanic laughingly called the test off by saying: "Why hunt further? I'll give up!"

—And yet Godfrey still finds the old argument in some railroad shops. Can you beat it?

Rifle and Shot Gun Manufacture

J. B. NEALEY
American Gas Association

Machining methods and heat-treatment in an old industry keep pace with modern trends

THERE are three ways of making a rifle barrel: rolling, as at the Springfield Arsenal; forging, as done by the Winchester Repeating Arms Company; and machining from bar stock, as at the Utica plant of the Savage Arms Corporation plant. The raw material used by Savage is in the form of steel bars $1\frac{1}{16}$-in. in diameter and of the same analysis as employed in the barrels of the government Springfield rifle. The analysis is:

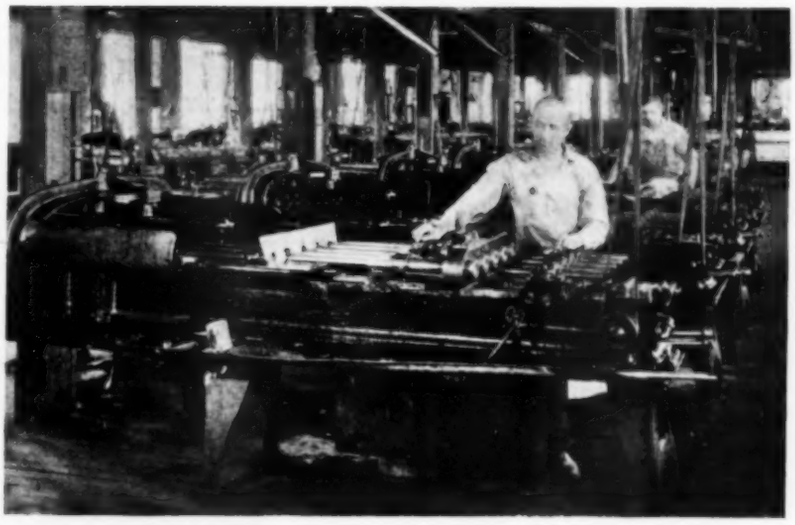
Carbon 0.45-0.55, Phos. max. 0.09, Manganese 1.00-1.30, Sulphur max. 0.06.

More than twenty-seven different types and caliber of rifle barrels, each requiring from 30 to 65 machine operations, are produced. The bars are chucked in special drilling machines, hollow drills for oil circulation being used, and rotated against the drills which are held stationary. With this method, the drill tends to center itself, and a straight hole through the center is obtained. A special machine reams the bores of eight barrels at one time.

The hollow bar is next machined in a lathe to the correct exterior shape and dimensions; octagon-shaped barrels are produced in multiple milling machines. For rifling, a special machine holding five barrels stationary is used. The cutters are fed through the barrels, set for cutting and drawn back, making six cuts for six grooves. A slow screw motion is given the cutter so that the grooves make the proper number of turns in the barrel. The grooves average 0.004 in. deep.

The cutter or rifling head consists of tubular steel in which the cutting tool is set. As this head emerges from the barrel, after making a cut, a mechanism engages it and raises the cutter another notch for the next and deeper cut. The cutter is drawn through a number of times to produce the proper depth and width of groove; this requires about 40 min. Chambering is accomplished on turret lathes, each equipped with seven special reamers, all of which are forced into the breech end of each barrel in progression. The end is then turned down and threaded for the receiver. Grinders and buffers are used for finishing.

Shot-gun barrels are produced in the same way except the rifling operations are omitted. The bores of all shot-gun barrels are machine lapped by forcing metal rods, wound with metal cloth, through them and at the same time rotating the rods at speeds ranging from 1,200 to 1,500 r.p.m. This operation heats the barrels so fast that they have to be lapped under water. Rifle barrels are machine lapped in a special machine with a reciprocating motion, using laps made of lead. The final glossy black finish is procured by applying an oxide-producing acid, steaming for 24 hr. and buffing. This process is repeated for three days in succession.

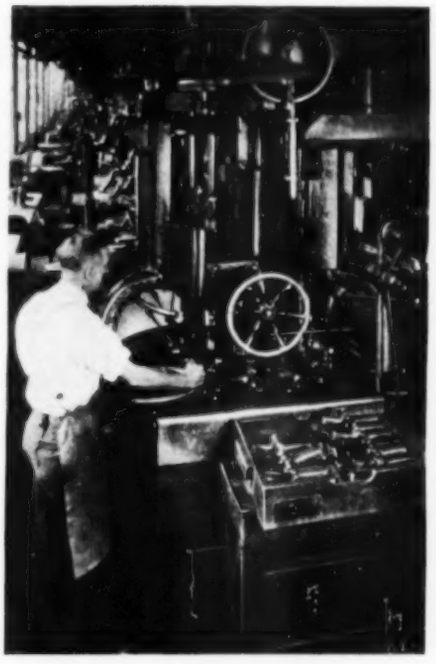


Barrels are drilled from solid bars by rotating them against stationary tools

Drop forgings are used for the receivers, and these are first chucked in vertical drilling machines where eight operations are performed on each forging progressively. These are:

1. Rough bore magazine hole,
2. Finish bore magazine hole,
3. Rough bore (to large diameter) bottom of magazine hole,
4. Finish bore and ream same,
5. Bore barrel hole,
6. Counterbore barrel hole (rough),
7. Counterbore barrel hole (finish),
8. Hob end for barrel.

In all it requires 108 operations to pro-



Eight operations are performed on the receivers in this special station-type machine

duce the receiver for the 99 Model rifle, while 780 operations are used in manufacturing this model complete.

There are many lines, groups and batteries of special machines for making the smaller parts such as bolts, striking pins, sears, triggers and trigger levers. Stocks and forearms are thoroughly dried in modern dry kilns, then sawed out and finished in the wood-working division which is completely equipped with up-to-date machinery. Large numbers of special tools, required in the manufacture of these guns, are made in the company's own tool and die shops.

The life and endurance of a gun depends upon the physical characteristics of the component parts, and these in turn are determined by the various heat-treatments to which the parts are subjected. The heat-treating division of this plant is housed in a room 50x150 ft. which is equipped with gas-fired furnaces throughout. These are arranged along the walls and in groups about the floor with quenches conveniently placed.

Annealing and pack hardenings are accomplished in four double-chambered. brick furnaces, steel incased, each 10 ft. wide, 8 ft. deep and 6 ft. high, and provided with counterweighted doors. These are under-fired with five gas burners on each hand. Alongside of the one used for pack hardening is a hooded quench tank.

Pack Hardening

Bolts, lifters, hammers and triggers are packed in welded steel boxes, 9x10 in., with two trunnions; a long pipe, with a head that fits over the trunnions, is used to charge the boxes into the furnaces. On withdrawal the contents of the boxes are dumped directly into the quench to retain their color, the door of the hood being closed to prevent the flash of the compound from bursting into the room. The parts are caught in a submerged, screen-bottomed tray while the compound is settled out of the water and reclaimed.

A row of four furnaces built of brick and incased in steel is used for miscellaneous heat-treatments. These are each 4 ft. square and are heated with two burners on each side, firing under the hearth. Carburizing is done in two types of furnaces, oven and rotary. The first includes two of brick and steel, each 4 ft. long, 3 ft. wide, and 4 ft. high, fired with six gas burners under the hearth. All these furnaces are on legs.

There are several of the rotary tilting types which consist of a steel shell, refractory lined, with an alloy steel retort within that is rotated by motor. These are 4 ft. long and 2 ft. in diameter and are heated with five burners on each side. Instead of using a carburizing compound, city gas, enriched by bubbling through gasoline, is circulated through the retorts. Another of these furnaces with one long pipe burner in the bottom, is used for blueing, bone dust being employed.

A temperature recorder with a multi-point switch is part of the equipment here, and this recorder charts the temperature of six furnaces at a time, in different colored inks. Visual pyrometers are also used.

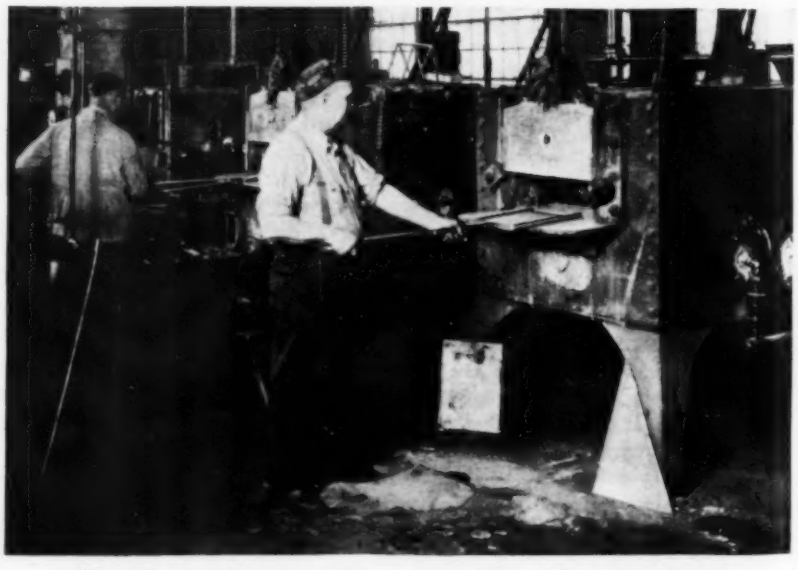
Cyanide pots are used for most of the hardening. There are five of these, each with its brick furnace some 3½ ft. in diameter which is heated by two burners. One oven type furnace, 4 ft. square and fired with four gas burners, is also used for hardening. For high-speed tools there are five small oven type furnaces. Spot hardening on the bolt lock in the receiver is done with a gas welding torch, the part being brought up to a cherry red (about 1,450 deg. F.) and then quenched in oil. This part is drawn back to 450 deg. F. in oil.

A battery of four niter pots with brick furnaces (two in each furnace) is used for annealing, drawing and blueing. The furnaces, 5 ft. long, 4 ft. wide and 3 ft. high, are heated with four burners each. There are also four oil tanks, each heated with a gas burner, in which different parts are drawn.

The oil quench tanks are supplied from a 10,000-gal. tank located outside of the building. The oil is pumped from this to the smaller tanks and the overflow returns by gravity to the larger tank. This recirculation keeps the quenching medium cool. Gas is supplied to the furnaces already mixed with air for combustion.

While the many types and calibers of

Stocks are hand-finished from kiln-dried wood



Miscellaneous heat-treatments are performed in a battery of four gas-fired furnaces

guns made here require a large number of small parts, only about fourteen different analyses of steel are employed, and eight of these are carbon steels. That used in the rifle barrel closely conforms to S.A.E. specification 1035.

Some parts are quenched in a solution of saltpeter and water for color as well as hardness. One of the screws is made from S.A.E. 2320 steel, hardened in cyanide, quenched in water and niter blued. On some models, many parts are S.A.E. 2345 steel. Other parts are of S.A.E. 6150 steel and are heated to 1,550 deg. F., oil quenched and drawn at 900 deg. F.

After heat-treating, all parts are sent to the stockroom and are requisitioned from there for assembly. Specially trained workmen are employed in the assembly department, for here more than 32 major parts are carefully assembled into the smoothly operating, finished rifle.

Many of the smaller parts are hardened in cyanide pots

Before final assembly all parts are carefully inspected

• NEW BOOKS •

MACHINE TOOL WORK — *By Prof. William P. Turner. 424 pages, 6x9 in. Published by McGraw-Hill Book Co., New York, N. Y. Price $3.00.*

As the author teaches practical mechanics at Purdue, he has naturally acquired a thorough knowledge of the different phases of work on machine tools that interest and puzzle the student. After a short, heart-to-heart chat with the the student and a chapter on general instructions, he divides the subject into sections that include tool shapes, speeds and feeds, and the metals commonly used. He then takes up the various kinds of work done on the lathe, shaper, planer, and milling machine. Gears and gear cutting, turret lathes, drilling and grinding machines, each have their chapter, as do keys and keyways and such miscellaneous problems as models, lathe centers, propeller hubs, reamers, tool maker's buttons and jigs. Fits and fitting receive attention, and the exposition of the difference between allowance and tolerance should be of great value. Each chapter is followed by a list of pertinent questions. While no book of this kind can make the student into a mechanic, this one shows him the essential phases of work to be considered.

APPLIED X-RAYS. *By George L. Clark, Ph.D. Four hundred and seventy pages 6x9 in. Published by the McGraw-Hill Book Company, New York, Price $5.*

This is the second edition which adds the progress made in six years to the data previously published. Among the advances made are the X-ray tubes that operate successfully at millions of volts, additional uses in medical science and, of special interest to readers of *American Machinist*, is the diffraction analysis of solid materials. The use of X-ray in the study of metals is growing, the chapter on the Structure of Alloys being a practical example of such uses. Such a volume is of course designed for use in the laboratory rather than in the shop. No chemist or metallurgist who wants to keep up to date can afford to overlook the developments in X-ray.

PETROLEUM PRODUCTS AND LUBRICANTS AND METHODS OF TEST RELATING TO PETROLEUM PRODUCTS—*Report of Committee D-2, American Society of Testing Materials. 286 pages, 6x9 in. Illustrated. Paper binding. Published by A.S.T.M., 1315 Spruce St., Philadelphia, Pa. Price $1.25.*

Test standards for petroleum products are summarized in this volume. There are 49 test methods given, 33 having been accepted as standards, 15 as tentative standards.

Revisions accepted at the June 1932 meeting, which involve test methods for flash and fire points with the open cup, the test for cloud and pour points, and test for viscosity are given in their latest form. The standard test method for distillation of natural gasoline, just adopted by the Society, is given as well as color tests for lubricating oils and for petrolatum with A.S.T.M. union colorimeter, test for gravity of petroleum products with the hydrometer, and test for vapor pressure of natural gasoline (Reid method), all of which were revised this year.

How to Buy Machine Tools—II

J. R. WEAVER
Works Equipment Engineer, Westinghouse Electric & Manufacturing Company

Getting facts from the machine tool salesman to sell the shop on the new equipment. What the salesman should know to be of greatest assistance to the buyer. Receiving, checking and installing a new machine

THE purchaser of machine tools must consider salesmanship from two angles: the one being the salesmanship of the man who is trying to sell him a machine tool; the other being the salesmanship that he must put forth himself in order to keep the shop satisfied with the purchases he may make.

So far as the purchaser of machine tools is concerned the more important of these two items is that of keeping the shop satisfied. If efficient operation is to be expected from machine tool operators and supervisors of machine shops they must receive the kind of machines they like best. It is often true that the machine tools they like best are not the most efficient for the particular operation to be performed, and it is therefore the buyer's duty to supply all the information he can on the various machine tools and then sell the shop people on the best tool for the operation. If a machine tool is not "sold' to the shop people and is put into operation over their objections, it is quite likely that it will never operate properly, not because the shop people may have any malicious intent but because they are not thoroughly sold on the machine and therefore may not take full advantage of its possibilities.

The machine tool buyer must adapt himself to the various types of machine tool salesmen that call upon him. No two salesmen present their propositions alike even though they sell similar machines. It is desirable, therefore, to know these various men so that information can be conveyed to them in the way they can best understand, and so that discussions with them may bring out the most information. There is no doubt but what the various contacts made in different manufacturing plants by the various machine tool salesmen should make them very well versed in methods of manufacture. It is the buyer's duty to learn as much as he can from the salesmen with whom he comes in contact, and to take advantage wherever possible of all good suggestions.

A salesman is naturally enthusiastic about the product he sells. He may even become over-confident in his recommendations and assume that he can accomplish much more than is possible with the machine tool that he sells. It is the buyer's duty to know when a salesman is promising more than he can fulfill and he should take the necessary precautions to purchase a machine that will do what is expected from it.

Unfortunately, some salesmen in the machine tool industry are not sufficiently familiar with manufacturing operations. They may know the construction of their machine tool in its entirety, but to be a good salesman, it is necessary to know more than just the construction of the machine. The most important asset a machine tool salesman should have is the ability to tool up a job. This is especially true when selling to large organizations.

The Buyer's Task

The shop is usually looking for better ways of doing a job. The buyer is requested to ascertain the best possible method of machining certain items, and he must have some plan or schedule of the kind of machines he should buy for these particular operations. These plans or schedules are either formulated by the buyer or supplied to him by someone in a manufacturing department who is assigned to this particular type of work. It must be evident that if a salesman is capable of tooling up a job he will be of a great deal of assistance to the buyer of equipment in lining up operations and selecting types of machines to be used. It is much more profitable to sit across the table from a salesman who can discuss these problems intelligently and, even though he may not be able to give definite time values, who can give this information accurate enough so that it can be used. It is then a simple matter to refer this information to the machine tool manufacturers for verification or correction of the time values submitted tentatively by the machine tool salesman.

Unfortunately, the usual procedure in such cases is the submitting of drawings and samples to the salesmen who has to send them to the machine tool manufacturer for production estimates and costs of machine. This usually wastes considerable time because the information may be misunderstood in the beginning, or because the machine tools recommended may not fit into the setup properly, or for various other reasons that may require going back to the machine tool manufacturer the second and possibly the third time. This is frequently due to the fact that the machine tool salesman is not familiar enough with tooling up jobs so that he can definitely understand what the buyer requires and transmit this information properly to the tool manufacturer.

Details of Construction

As mentioned above, the most important factor in selling is knowing how to tool a job. However, it is also very essential that the machine tool salesman know the details of construction of the machine tool. The buyer usually wants to know as many of these details as possible. Especially those that do not frequently buy machine tools must make doubly sure that the machine will withstand the wear and tear expected of it. Small shops are probably less concerned about high production than is the case in a large shop. But they want more universal equipment so that it can be applied to a variety of operations or jobs.

I have always tried to be as honest with a salesman as I am with any of the men that work directly for me. I have always assumed, as a buyer of machine tools, that the machine tool industry works directly for me. As a buyer of machine tools, I have a perfect right, in my opinion, to call upon any sales engineer or service man in the machine tool industry for help on his particular machine just as I would call for any of the men reporting directly to me. I fully believe that the machine tool industry is willing to cooperate to this extent. I believe if every buyer would look upon

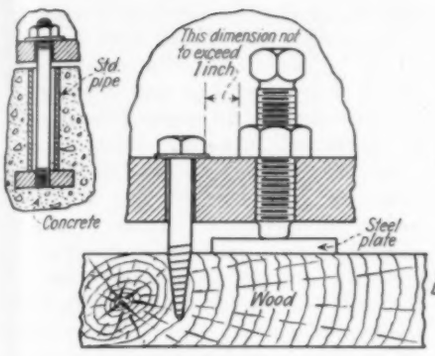
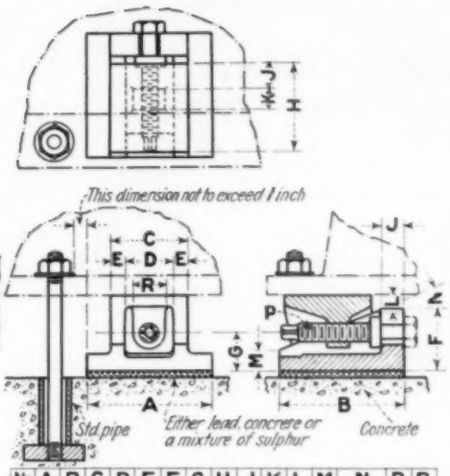


Fig. 4—Standard leveling device for machines not requiring a foundation



No	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R
1	6	7½	4½	3	⅜	3	2	5½	1¼	1½	1"	⅞	18°-46'	1-8 Thd.	2½
2	6	10	4½	3	⅜	4	2	7	1½	1⅜	1¼	1⅛	18°-46'	1-8 Thd.	2½

Fig. 5—Standard leveling device for heavy duty equipment

the machine tool industry in this light, there would be more cooperation between the manufacturers and users of machine tool equipment than there has ever been in the past. There would be a better exchange of ideas and less delay in transmitting the proper information.

Although a salesman may be selling one type of machine only it is very desirable for him to know in general the possibilities of all the different kinds of machine tools. If the buyer wants help and the machine tool salesman can furnish some advice or information, it will always be appreciated. It is never possible to know too much about the product you may be selling, and a salesman should keep himself thoroughly posted on it, but as mentioned above, knowing the possibilities of different machines may help considerably in getting an order.

It has often been said that orders are received based on the kind of service given by the supplier. This is very true because at the present time nothing is purchased until it is needed. Therefore, it is desirable to give quick delivery and, when a machine tool is delivered that does not function satisfactorily to start with, to have a means of supplying the necessary information either by an instruction book or through the efforts of a service man. This is one type of service that is very important and should be followed very closely by the machine tool industry. There is nothing more aggravating than to buy a machine tool expecting to produce certain results, and to find, after it is received, that it is no better than, or not as good as the old machine tool so far as production is concerned.

All these things create what we call confidence in the salesman. Every salesman should try to obtain the confidence of the buyer. This can only be accomplished in one way, by representing the things that he sells accurately and efficiently, and by giving the service that is required from him in this particular business promptly and cheerfully. Since in this particular case we are dealing with human nature and every case must, of course, be handled individually, the confidence built up must be based on the characteristics of both the buyer and the saleman.

Agreement on Details

Let us assume that the machine tool salesman has been interviewed, the shop people have been checked, and the machine has been selected. The buyer has been requested to prepare a purchase order for the machine tool decided upon by those in authority. Costs of the machine tool and production estimates have been properly checked by the shop.

The salesman, of course, has submitted a quotation in which he stated what his company would supply, giving the amount for the machine and any accessories that should go with it, also the guarantees on production estimates depending in each case upon several variable factors. These variable factors include the kind of material, the amount of stock allowed for finish and the kind of finish required, the accuracy demanded, and several other things usually involved in machining a product. All these things should be definitely decided upon while negotiating the machine and should be incorporated in the purchase order or contract so that there is no misunderstanding. It is not fair to the machine tool manufacturer to buy a machine from him expecting one thing and allow him to believe that he is supplying a machine for something else. Regardless of what the final outcome may be, if there is a misunderstanding it usually costs both parties a lot.

Frequently the question comes up as to where the machine tool manufacturer's responsibility ends. It has been suggested that the machine tool manufacturer build a machine to certain specifications and the user accept this machine and all the troubles that may go with it when putting it into operation. This undoubtedly would reduce the cost of manufacturing machine tools considerably, since the machine tool manufacturers are now giving extensive service to the users of their machines in starting a machine tool properly when it is installed in the user's shop. The reduction in the selling price of machine tools would not offset reductions possible through the incentive that is set up by requesting the machine tool manufacturer to be responsible for his machine until it is producing what is expected of it. Therefore, I believe the machine tool manufacturer's obligations do not end until the machine tool is producing what was agreed upon before the machine tool was purchased. Furthermore, the machine tool purchaser expects the machine to be sufficiently rugged to withstand the general practices and usages of machine tools.

It is very important to have a good organization to receive machines that are purchased, because much damage can be done when unloading a machine if it is not properly handled. A great deal of time can also be wasted in handling the machine from the car to its location. Apparently there is no particular standard set-up in the method of crating and shipping machine tools so a universal set-up must be made to handle this situation.

After the machine is delivered to its location, an accurate check should be made of all various parts. It is very aggravating to learn that after partially assembling a machine certain parts are missing. This is true especially of small detail parts such as special wrenches and tool holders.

Installing the Machine

The proper installation of a machine tool on its foundation is of prime importance. A great deal of damage can be done, or the proper functioning of the machine can be considerably delayed if the machine is improperly installed. Naturally, it is desirable to have the location prepared, foundation installed in line with foundation prints supplied by the machine tool manufacturer, and whatever leveling devices are necessary ready so that there is no delay after the machine is received.

More or less discussion has taken place

New Machine Tool Installation Report
Westinghouse Electric & Manufacturing Company

(See reverse side for duplicate of Contract and description of machine).

Brass Tag No. ..... Mfg. Serial No. .....

Location: Department ..... Section ..... Column .....

Motor Tag No. ..... H. P. ..... R. P. M. .....

Operations to be performed on this machine:—

Item	Date	Signatures
Electric Apparatus Approved		
Safety Devices Approved		
Machine Accepted by Department		
Time Study Department Savings Estimates.—First three months		$
Yearly		$
Noted:—Time Study Department		
Noted:—Mfg. Cost Analysis Department		

Report Completed—Date .....

..... Demonstrator

REMARKS:

Report Approved—Date ..... Manufacturing Equipment Dept.

..... Supt.

This sheet to be filed with contract in Works Equipment Department.

Fig. 6—Check sheet for machine installation

as to the proper method of leveling a machine tool. Many different methods have been suggested but the usual method is to use leveling wedges for heavy machinery and shims and liners for light machinery. It seems as though a great deal of time could be saved if some standard were adopted for this particular operation. Figs. 4 and 5 show proposed methods of installing heavy and light machinery. If leveling blocks were standardized so they could be manufactured in large quantities, it would undoubtedly reduce their cost considerably. As it usually is, each manufacturer makes his own leveling blocks, the result being a great variety in design and needless cost.

The simplest method is to use leveling screws. A number of tests have been carried out to show whether leveling screws would hold the machines sufficiently rigid. All tests showed very satisfactory results and at the present time some of the most accurate machines are installed on leveling screws, which would indicate that this method of installation should be entirely satisfactory. From the cost standpoint, this method is much less expensive than any other known method. It is a very simple matter to receive a machine properly equipped with leveling screws, set it in its location, and in a very few minutes level it properly. Practically all machine tool bases are sufficiently rigid that a hold-down bolt placed as close as possible to the leveling screw will not distort the bed.

Most machine tools today are driven by individual motors. Therefore, care should be taken that the wiring is neatly and properly done. Special care should be taken that the motors are wired for the proper rotation before starting a machine. Lighting plays a very important factor in production. A light should be located conveniently that will give the maximum lighting efficiently at the desired location.

All states at this time insist on proper safeguarding of all machine tools. Each state apparently has its own laws in this respect and therefore it becomes more or less the machine tool builder's obligation to supply proper guards for machine tools. Fig. 6 shows an installation sheet which required the inspection of every major operation in the installation of a machine tool. It delegates responsibility to certain individuals for each of these operations and, when properly approved, assures that the various operations have been checked and the machine properly installed. Delegating responsibility in this way always brings entirely satisfactory results.

Since a new machine tool usually entails a fairly large investment of money, it is desirable to start it properly and this can best be accomplished with an experienced operator. When a machine tool is ready to run, an experienced man should be assigned to insure proper adjustment of all parts, proper lubrication, and the proper starting of the machine itself. The larger users of machine tools usually have a group of experienced men of this character who are assigned to such work. One of their duties is to follow the machine from the time it is received until it is turned over to the production department. The installation sheet mentioned above shows in this particular case that the demonstrator was responsible for seeing that each operation was properly performed and approved by the responsible person in the department doing that work.

In case of a machine for a production job, where the machine tool manufacturer has guaranteed a certain production from the machine, it is advisable to have a machine tool representative start the machine and demonstrate whether the machine will produce the work guaranteed or specified at the time of purchase. In this case, the factory representative will see that the machine is properly started and will run it until such time as the production estimates are met. In this way, there is no misunderstanding as to what the machine will produce, and in case it does not meet expectations, any changes necessary will be under the direction of a factory representative. There will be less misunderstanding between the user and the builder of the machine if a factory representative is present when the machine is started.

Satisfying the Operator

All disputes and disagreements should be settled in their entirety before the machine tool is turned over to the production department. The man that is going to use the machine tool must be thoroughly satisfied that he has the best machine obtainable for that particular operation. If he can be assured of this fact, there is no doubt but what he will produce more work than if there is a doubt in his mind in this respect. Nothing should be left undone even to the point of putting the floor around the machine in good condition and removing any excess material that may have been left near the machine after it was installed. This assures a first-class job and the machine should produce first-class class work.

[*Second of three articles. The third will appear in the next issue.*]

EDITORIALS

AMERICAN MACHINIST
VOLUME 77 ESTABLISHED 1877 NUMBER 4
McGRAW-HILL PUBLISHING COMPANY, INC.
K. H. CONDIT F. H. COLVIN
EDITORS

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Unemployment Insurance

Management is facing a new problem. While not unexpected by those who watch the trend of events, the possibility of unemployment insurance was brought definitely nearer by the action of the American Federation of Labor last fall. After steadfastly opposing it for several years in the hope that business revival would make it unnecessary, the Federation leaders now feel that in spite of its objections, employment insurance has become necessary.

The time has come to study the matter with an open mind. Industry has the opportunity either to show a better method of handling unemployment or to aid in formulating laws that will avoid abuses and impose the least burden on all concerned. The complete failure of Germany's carefully worked out plan is a warning that should be heeded.

Sam A. Lewisohn, speaking before the Personnel Conference of the A.M.A. a few days ago, pointed out the distinction between fair-weather or seasonal unemployment and hard times unemployment. Dismissing the first type as being temporary and localized, Mr. Lewisohn urged the vital need of some sort of reserve for the hard times or "epidemic" unemployment. If you eliminate the minor risks in any form of insurance, he observed, your premium will go very much farther in buying protection. For this reason he advocated a long waiting period, at least sixty days, before benefits would begin. He also warned against state-administered pools because of their tendency to preserve dying obsolete industries, and against individual company-operated ones because of the danger of the weak ones throwing their men on the community much earlier than would be the case if a whole industry cooperated.

Isn't it obvious that employers in every industry should get their own thinking on this important subject straightened out, and then make sure that their ideas are conveyed to the various legislatures?

"Gyp" Parts

To those branches of the metal-working industry where production is large enough to make the supplying of "gyp" parts an attractive enterprise, the activities of the "gyps" have been decidedly annoying. A booklet has just been sent to us that attacks the problem constructively, and so effectively that we call attention to it.

The Caterpillar Tractor Company is the publisher of the booklet. In it are comparisons between the laboratory and inspection tests of corresponding replacement parts, made by the company and made by "gyp" suppliers. In both material and workmanship the "gyp" part fails to come up to the standard part by a wide margin.

For instance, Brinell hardness of one "gyp" part is 156–170, of the corresponding standard part 285–341. Bored holes in the "gyp" parts are oversize, out of round and not parallel. Bolt holes are as much as a sixteenth of an inch out of line.

In the booklet the "gyp" part and its specifications appear on one page, the standard part and its characistics on the facing page. The contrast is so striking and the message so convincing that we do not hesitate to recommend the method to other manufacturers who face the same trouble.

Does Rehabilitation Pay?

A builder of special machinery yielded to the arguments of Robertson committeemen and bought half a dozen much-needed machine tools. Six weeks later he was one of five bidders on a rush order for a battery of special machines. He had the equipment, he had the engineers, he had the machinists to meet the quick delivery demanded. Also, he had the initiative to go after the order hard, and the backbone to insist on a fair price. He got both.

On this order he made a profit that covered half the cost of the new equipment that had made its capture possible. A competitor accused him of cutting prices, until he was shown the signed order.

Does rehabilitation pay? Yes, if it is backed up by alertness, aggressiveness and ability to meet difficult conditions.

Invention Minus Necessity

Necessity may be the mother of invention in some cases, but in many others invention gets to be a grandmother before the idea finds practical application. One good illustration is the process of spraying with metal. Without going into ancient history we can safely say that the invention is at least twenty-five years old. If necessity had anything to do with it she must have been easily satisfied because applications have not been numerous enough to indicate the existence of a crying demand previous to the invention.

There is no doubt that necessity has spurred invention, but there are many useful inventions, such as the metal spray, which have wide possibilities but which require such a change of ideas on the part of those who should be interested that introduction is a

slow process. Such devices or methods require much education of those who will benefit most by their use. Salesmanship and demonstration rather than a feeling of necessity or an existing demand offer the only means by which many useful devices can be put on the market.

Inertia is the great obstacle to getting machinery of any kind in motion. Human inertia is even more difficult to overcome. This is why the work of the salesman, the printing press and the business man is necessary to get even the best of inventions into general use in the community.

Just Suppose

Just suppose we had a super-industry commission that could dictate improvements as the Interstate Commerce Commission dictates them to the railroads. Following the lead of the I.C.C., which has just ordered power reverse gear to be applied to over thirty thousand locomotives, this body could direct that all obsolete power plants be brought up to date, that all machine tools be rebuilt to be able to pull tungsten carbide tools, that all automobiles be equipped with automatic clutches, and so on.

Smacks a little too much of technocracy to be palatable to our wild, free taste, perhaps, but what a lot of work it would make for the equipment industries if such a direction were imposed on us. Just suppose!

• CHIPS •

Roosevelt outlines plan for developing Tennessee River valley . . . declines to guess cost and offers no definite financing program . . . Senate Finance Committee invites bankers, industrial leaders, publishers and educators to appear before it and point the way out of the depression . . . Deficit reaches $1,270,000,000 in seven months . . . House lowers funds for Federal Trade Commission by 65 per cent . . . Hoover addresses meeting of state tax legislation committees . . . Roosevelt invites governors of all states to meet him March 6 to plan united drive to end depression . . . Senate passes bill giving Roosevelt wide power to reorganize administrative agencies . . . Hoover voices approval . . . House expected to concur . . . Smith calls for U. S. Dictator of Public Works to cut red tape and get action . . . Senate considers various bills to lower interest rates . . . gets all stirred up and fires sergeant-at-arms because he said most congressmen were honest.

Mutinous crew decamps with battleship to beat the Dutch . . . Japan speeds up war machine . . . argues with League . . . Italo-German Fascist rapprochement worries France . . . Chamberlain's pugnacious debt pronouncements anger U. S. Senators . . . their rejoinders are equally effective in dampening any enthusiasm for reasonable discussions . . . Russia rushes recalcitrant Cossack peasants to semi-arctic wastes . . . disciplines scores of party leaders . . . Sandino and Sacasa celebrate end of Nicaraguan row . . . Argentina and Chile inquire diplomatically whether six-months fighting between Bolivia and Paraguay is a war . . . munitions transport across neutral territory involved . . . Poland announces return to the gold standard . . . Mussolini moves to reorganize Italian industry by state-controlled financing corporation . . . British leaders talking quietly about a similar move . . . Cuban troubles coming to a head . . . Australia has done the things we talk about doing and is staging a powerful comeback . . . Hitler becomes German chancellor heading a cabinet of right wing affiliations . . . republicans apprehensive for Weimar constitution . . . foreign opinion hopeful responsibility will moderate Hitler's enthusiasm . . . Reichstag dissolved preparatory to general election in March . . . trouble likely to come then . . . Duc de Guise issues call for establishment of French monarchy with himself as king and dictator . . . Cabinet gives up trying to balance French budget.

Steel ingot output gains . . . Electric power output recedes slightly . . . Commodity prices weak . . . Security markets stronger . . . Briggs resumes with rehired men and strike breakers . . . Ford gets going again and announces the larger of his new cars . . . Hudson body makers go out and plant closes down . . . Communistic activity blamed for troubles . . . Chrysler and Graham step up production . . . General Motors reports much improved sales . . . Chicago show far better than last year's in attendance and sales.

E. W. Bliss plant in Salem, Ohio, resumes with six months' business ahead, a $500,000 sheet rolling mill for Gary . . . Pratt & Whitney Aircraft books War Department order for 28 engines . . . Reading R.R. completes electrification of two branches . . . Brooklyn subway link opens . . . British flyers break distance record by flying 5,411 miles from Cranwell, England, to Walfish Bay, South Africa . . . Goodrich share-the-work effort keeps 500 on job.

U. S. Steel cuts preferred dividend . . . Studebaker passes preferred first time in 20 years . . . Black & Decker cuts capital represented by 298,354 no-par common shares from $6,262,730 to $1,491,770 . . . Hoover and Tariff Commission set top rate on rubber shoes . . . Standard Oil of N. J. pays regular dividend but omits customary extra . . . Drug, Inc., cuts from $4 to $3 . . . A. T. & T. continues at usual rate . . . General Motors does likewise.

Bliss Gets Rolling Mill Order

Operation for at least six months is assured the Salem, Ohio, plant of the E. W. Bliss Co. because of a $500,000 order for a rolling mill from the American Sheet & Tin Plate Co., U. S. Steel subsidiary. According to its manager, Lloyd Jones, this Bliss plant normally employing about 100 men has been closed for over a year.

The new mill for making cold-rolled sheets and strips up to 72 in. wide will be the largest of its type in the world. Steel forgings instead of castings will be used for the housings.

Motor Output Up

According to a report of the National Automobile Chamber of Commerce the production of passenger cars and trucks of its members for January was five per cent above that of the same month in 1932. The estimated output of 115,915 cars exceeded the December total by 38 per cent. This figure is higher than any month of last year with the exception of March and April.

Rehabilitation Projects Now at $155,000,000

On February 6, A. W. Robertson, chairman of the National Rehabilitation Committee, announced that the total expenditures planned by industrial plants and retail business establishments have now reached $155,049,702. The previous report showed $142,115,351 to be spent for modernization. The reports of the activities of the committees in the Federal Reserve Districts show the following results:

District	1. Boston	$2,127,321
	2. New York	2,887,672
	4. Cleveland	11,697,790
	5. Richmond	220,000
	6. Atlanta	6,555,000
	7. Chicago	11,531,064
	8. St. Louis	10,337,371
	9. Minneapolis	725,000
	10. Kansas City	4,643,804
	12. San Francisco	36,841,430

Other large scale commitments, previously reported by the national committee, bring these figures up to the new total.

Commenting on these results, Chairman Robertson said, "In reporting these figures, the national committee does so as a matter of public information, so that the whole country may know of the progress of the modernization movement whether it is due directly to the activities of the committee or not. It is not a matter of vital importance as to where credit for each rehabilitation project rests. It is important for the whole country to know that the movement for modernization is progressing naturally and having a beneficial effect on business and on employment."

Detroit Strikes Threaten Open Shop

Although operations have resumed somewhat, the Detroit labor situation is by no means settled. Following assurance of a minimum wage limit and elimination of the dead time provision, strikers demanded recognition of group bargaining which would result in unionization of the industry.

There is evidence that Communistic forces have been active as claimed by the manufacturers. However, Mayor Murphy's fact-finding committee reports some of the workers' grievances well founded because of unprecedented wage cuts.

Coes Heads Engineering Trustees

HAROLD V. COES, manager of the industrial department of Ford, Bacon & Davis, was elected president for 1933 of United Engineering Trustees, Inc., joint agency of the four founder engineering societies. Mr. Coes succeeds HARRY A. KIDDER, superintendent of motive power of the Interborough Rapid Transit Co.

HAROLD V. COES

CHARLES A. MEAD, chief engineer of the division of bridges and grade crossings of the Board of Public Utility Commissions of the State of New Jersey, becomes first vice-president. R. M. ROOSEVELT, vice-president of the Eagle-Picher Lead Co., was chosen second vice-president.

CLIFFORD P. HUNT, vice-president of the Chemical Bank and Trust Co., was re-elected treasurer, and ARTHUR S. TUTTLE, consulting engineer of the Board of Estimate and Apportionment, New York City, assistant treasurer. ALFRED D. FLINN continues as secretary, and HENRY G. MORSE as consulting architect. Parker & Aaron were retained as legal counsel, and Wood Struthers & Company as financial advisers.

Mr. Coes, Mr. Tuttle, and JOHN V. N. DORR, president of the Dorr Co., were elected members of the board of the Engineering Foundation, research department of United Engineering Trustees.

• INDUSTRIAL REVIEW •

It is becoming increasingly evident that there will be no appreciable gain in machinery and machine tool business until after March 4. Inquiries, what few there are, seem to be mostly for used equipment. The general impression, however, is that, after a dull first quarter, 1933 business will improve and probably exceed that of 1932. Some few machine tool builders have been helped by foreign orders.

Chicago correspondents report that business there is either marking time or has slowed up since the first of the year. Milwaukee is also at a standstill, both in business and physically because of the blizzard. St. Louis says that a few used machines have been sold, but that there is no inquiry for new ones.

In Indianapolis unemployment has reached a new high and the outlook for the manufacturing industries of the district is anything but bright. February is expected to be a very quiet month in Cincinnati. In the metal trades, 13 more men found employment in January than in December. A little machine tool business has been placed in Detroit but the recent labor troubles have been effective in stopping further developments.

In Cleveland occasional single large orders have been placed but the general volume of business is low. Automobile parts companies have suffered from the Detroit shutdowns. More people are being put to work and it is encouraging to note that there seems to be little tendency to take advantage of distress by offering starvation wages. Pittsburgh reports no change since the last report, two weeks ago.

Philadelphia is working hard on its "Renovize" campaign but the effect of the campaign on machinery business is hardly noticeable. Reports from Boston vary from "a few used machines sold" to "nil." Nothing of importance has happened in the New York territory.

Imports Drop, Exports Rise in British Machine Tool Market

LONDON — Preliminary 1932 official figures for overseas trading for Great Britain show total exports valued at £365,137,785 with re-exports at £50,913,593 and imports at £703,132,725. The balance of imports over total exports is rather more than 287 million pounds. This compares with about 406¾ million pounds for 1931. No estimate has yet been made to show whether the adverse balance of payments will be completely offset by so-called invisible exports; these were calculated officially to have reached rather more than 300 millions in 1931.

It will be noted that the fall in exported manufactured articles was small relative at any rate to the imports. In imports the drop in iron and steel and manufactures thereof was £10,956,379, in non-ferrous metals and manufactures thereof £6,705,892, in electrical goods and parts £3,503,278, in the machinery class £5,009,340, and in vehicles, a class which includes locomotives, ships and aircraft, £1,120,910. Similarly in exports of British manufacture the decline in iron and steel and manufactures thereof was £2,333,205, in non-ferrous metals and manufactures thereof only £49,777, electrical goods and apparatus £1,589,574, machinery £3,482,871, and in the vehicles class £8,969,625.

In the vehicles class, a really outstanding feature is the decline as regards ships. The value in steam vessels exported fell from £6,972,185 in 1931 to £2,878,866 last year, while motor vessels fell similarly from £2,735,688 to £389,437. The export of locomotives dropped from £1,496,869 in 1931 to £305,958, exclusive of parts, while the figures for carriages fell from £1,168,578 to £404,075, and for wagons and trucks from £945,027 to £344,582. The value of private motor cars on the other hand sent abroad rose from £2,649,864 in 1931 to £3,445,626. Commercial vehicles dropped from £786,555 to £518,255, and tractors from £54,957 to £22,276. Including parts and accessories but exclusive of tires and tubes, the total of motor cars exported amounted to £7,265,396, as against £6,535,852 in the preceding year.

A return obtained from the British Board of Trade shows that exports of British machine tools advanced to a weight of 23,775 tons valued at £3,138,834, or about £132 per ton. These figures have not previously been approached. Lathes to the value of £1,105,197 were shipped, or one-third of the total value, the weight being 8,238 tons; the ton value at £134 about equals the average. Next on the list as regards value exported are drilling machines, with 3,012 tons at £445,199, or about £148 per ton. For grinding machines the figures are 1,902 tons valued at £366,633 or £193 per ton. Milling machines were exported to the weight of 1,277 tons valued at £219,280, or £172 per ton, while the 3,158 tons of planing and shaping machines sent abroad were valued at £423,703 (£134 per ton), and presses were exported to the weight of 2,819 tons, valued at £177,560, or £63 per ton. In the miscellaneous class 3,343 tons were sent away, valued at £388,322, or £116 per ton, and the 24 tons of chucks, etc., exported were valued at £12,940.

As to re-exports, that is exports of imported machine tools, these totalled 121 tons valued at £27,320.

Imports of machine tools showed a definite decline, namely, 4,405 tons valued at £949,823, as compared with 10,813 tons valued at £1,615,790 for 1931. These are corrected figures. Losses are shown in every type. On the other hand, there was a marked increase in values per ton, which on the average rose to £216, despite the fact that the 1,307 tons of presses, punching and shearing machinery brought in were valued at £156,749 or £112 per ton. Drilling machines were entered as 184

British Imports of Machinery

	Quantities			Value		
	1930 Tons	1931 Tons	1932 Tons	1930 £	1931 £	1932 £
Agricultural	9,494	11,352	6,797	620,418	762,304	504,010
Boilers and boiler house plant	1,798	966	669	192,931	134,756	86,271
Dairy machinery	1,007	1,115	472	185,672	208,159	102,746
Electrical machinery	5,681	4,919	2,020	818,233	1,636,158	844,862
Machine tools	10,948	10,813	4,405	1,713,458	1,615,790	949,823
Mining machinery coal cutters	111	115	66	41,272	44,242	22,147
Prime movers (not electrical)	13,258	2,970	599	1,378,405	413,766	137,716
Paper-making machines	1,168	1,345	2,671	187,734	211,531	330,841
Printing, book-binding machines	6,776	4,050	1,940	1,569,771	1,023,256	542,026
Pumps	3,229	2,005	606	510,343	298,431	142,858
Sewing machines	558	699	263	167,324	206,815	96,767
Sewing machine parts	960	792	438	436,836	397,680	375,825
Textile machinery	5,465	5,796	7,843	1,102,225	1,117,885	1,163,265
Typewriters	875	1,074	336	596,561	628,662	270,015
Typewriter parts	95	97	34	91,741	91,494	33,485
Machines and machinery, all other sorts	46,689	44,740	23,923	7,307,554	6,548,102	4,712,002
Total of machinery	108,112	92,848	53,082	17,920,478	15,339,031	10,314,659

British Exports of Machinery

	Quantities			Value		
	1930 Tons	1931 Tons	1932 Tons	1930 £	1931 £	1932 £
Agricultural	21,600	12,431	7,902	1,644,628	966,542	620,535
Boilers and boiler house plant	62,762	50,914	29,434	3,325,078	2,549,984	1,422,972
Cranes, hoists, etc.	34,669	21,504	18,896	2,208,722	1,450,427	1,302,600
Electrical machinery	41,212	27,247	24,577	6,345,621	4,357,837	3,687,337
Grain milling machinery	3,078	2,437	1,864	286,386	228,174	183,219
Machine tools	13,915	15,495	23,773	1,856,226	2,237,457	3,138,834
Sugar-making and refining machinery	5,694	4,048	15,326	342,215	240,379	744,862
Prime movers	37,498	23,810	19,316	4,130,720	2,892,914	2,284,651
Paper-making machines	1,970	1,484	2,600	237,854	193,709	352,441
Printing, book-binding machines	4,862	3,042	3,468	1,120,848	728,031	753,743
Pumps	8,147	6,216	5,153	1,214,896	862,135	736,348
Sewing machines	857	667	468	172,751	123,085	104,278
Sewing machine parts	20,759	14,099	6,012	2,026,176	1,362,902	638,912
Textile machinery	91,212	55,567	63,070	8,628,162	5,280,713	5,511,157
Typewriters	50	25	22	89,139	47,878	52,955
Typewriter parts	39	57	63	60,402	56,871	70,625
Woodworking machinery	1,436	813	713	196,203	121,332	96,274
Machines and machinery, all other sorts	132,126	89,408	79,127	12,987,979	9,311,269	7,827,025
Total of machinery	481,886	329,264	301,784	46,974,006	33,011,639	29,528,768

British Re-Exports of Machinery

	Quantities			Value		
	1930 Tons	1931 Tons	1932 Tons	1930 £	1931 £	1932 £
Agricultural	755	814	131	56,230	57,387	14,208
Dairy machinery	131	119	40	21,129	20,467	8,812
Electrical machinery	351	303	200	139,537	116,265	85,195
Machine tools	262	294	121	52,502	55,978	27,320
Prime movers	178	507	38	39,726	55,787	11,973
Printing, book-binding machines	208	149	74	67,214	64,337	31,157
Pumps	220	147	100	38,717	27,150	20,796
Sewing machines	31	22	16	23,483	16,086	12,908
Sewing machine parts	464	320	287	208,521	138,604	189,946
Textile machinery	259	169	210	113,528	95,532	114,480
Typewriters	60	52	43	52,507	45,316	41,271
Typewriter parts	7	4	1	5,843	3,953	3,655
Machines and machinery, all other sorts	3,404	2,122	1,232	737,608	507,083	347,497
Total of machinery	6,330	5,022	2,493	1,556,545	1,203,945	910,218

Distribution of Machine Tool Exports

	Tons	£
To countries of Europe...	20,137	2,692,698
Union of South Africa...	311	37,913
British India.....	1,532	148,178
Australia.....	87	12,656
Other countries.....	1,706	247,389
	23,773	3,138,834

tons at £49,230 or £268 per ton, grinding machines 440 tons at £137,553 or £306 per ton, lathes 430 tons at £113,651, or £264 per ton, milling machines 437 tons at £81,986 or £187 per ton, with planing and shaping machines 167 tons at £55,429, and the unusual ton value for this class of £332. The total of the miscellaneous class amounted to 1,300 tons valued at £343,563, which with 41 tons of chucks, etc., at £11,752 completes the list.

While engineers' tools, such as stocks and dies, wrenches, spanners, but excluding gages, show a slight increase in exports, being valued at £309,927, a sharp decline is seen in imports which were valued at £145,487 and in re-exports at £34,382.

The explanation of the rise in exports lies solely in orders obtained from Russia, on which for export purposes at least British machine tool makers depend markedly. This will be seen in the table which shows the distribution of British machine tool exports. For the most part, the countries of Europe mean Russia. After Russia, Japan, France and South America follow at a distance. The continued dwindling of the British dominions areas, namely, South Africa, British India and Australia, is also obvious when comparison is made with the figures for preceding years. Going back five years, exports last year to South Africa did not reach half the value of 1927, while the value sent to British India was reduced almost to one-third and the Australian market did not reach one-fifteenth its former value. Imports of machine tools are still mainly from the United States and Germany.

Shidle Becomes Executive Editor of S.A.E. Journal

During Automobile Show Week in Chicago, the appointment of NORMAN G. SHIDLE as executive editor, the *S.A.E. Journal* was announced by John A. C. Warner, secretary and general manager of the Society. Mr. Shidle was formerly directing editor of the Chilton Co. and editor of *Automotive Industries*. He is considered an authority on automotive subjects because of experience gained in thirteen years of journalistic and merchandising activities in this field.

JULIAN CHASE, who assumes Mr. Shidle's duties as directing editor of the Chilton Co., has announced that DON BLANCHARD will take over the editorship of *Automotive Industries*. Mr. Blanchard will be succeeded by LEON F. BANIGAN as editor of *Automotive Trade Journal*.

Dodge to Represent Industrial Artists

WILLIAM W. DODGE, formerly managing editor of *American Machinist* and more recently managing editor of *Product Engineering*, has resigned his present position to act as adviser on product design and as eastern business repre-

sentative for a group of outstanding industrial artists and designers: Joseph Sinel, Lucian Bernhard and Helen Dryden. All three artists have achieved international recognition in the field of product design and redesign, packaging, posters, trade marks and other forms of industrial art.

Headquarters have been established in the McGraw-Hill Building, 330 West 42nd Street, New York, N. Y., but each artist will maintain his individual studio.

Mr. Dodge is a graduate of Cornell University. Before joining the McGraw-Hill organization, he was district manager for the C. O. Bartlett & Snow Co., vice-president of Dodge Manufacturing Corporation and general manager of National Veneer Products Co.

A.S.M.E. Active in Research

A high degree of activity was maintained during 1932 by the 28 cooperative research committees operating under the auspices of the American Society of Mechanical Engineers. Some 470 engineers representing manufacturers, users and independent interests were engaged in this work.

Relying as they do to a great extent on the support of industry, it was only natural that the activities of these committees should be curtailed somewhat during the past year of depression. However, expenditures were approximately $41,000, only 20 per cent below that of the best previous year. This record is an indication of industry's belief in the value of research at all times.

Subscribed funds were spent chiefly on experimental work in various institutional laboratories throughout the country. Twenty men were maintained on whole or part time at the National Bureau of Standards, Washington, D. C., and Columbus, Ohio; Battelle Memorial Institute, Massachusetts Institute of Technology, University of Michigan, University of Illinois, Ohio State University, Union College and Carnegie Institute of Technology. A.S.M.E. committees are also large supporters of research fellowships in the United States.

•BUSINESS ITEMS•

The Thomson-Judd Wire Machinery Co., Lynn, Mass., has been incorporated as a subsidiary of the Thomson-Gibb Electric Welding Co., of Lynn, Mass., and Bay City, Mich. The new subsidiary will manufacture a complete line of wire drawing machinery, stranders, insulating machinery, galvanizing, annealing and tinning equipment, wire welders and brazing machines. Officers are: GEORGE A. CUTTER, president; JOSIAH JUDD, vice-president and general manager; DANIEL J. LYNE, secretary, and A. P. REED, treasurer.

A new department, to be known as the Motor & Generator Engineering department, has been formed at the Schenectady Works of the General Electric Co., according to B. L. DELACK, manager of the works. The department will take over all the responsibilities of the former A.C. and D.C. engineering departments. Appointments are as follows: EARL S. HENNINGSEN, engineer in charge; J. L. BURNHAM, designing engineer; I. A. TERRY, assistant engineer, and A. C. WOOD, consulting mechanical engineer.

The Despatch Oven Co., Minneapolis, is making arrangements to cover each principal city with a sales representative. Recent appointments or changes in the engineering and sales personnel are as follows: K. J. PAPKE, 1012 N. 3d St., Milwaukee; E. C. BUEHRER, 669 Howard St., San Francisco; W. GLEN TIPTON,

of the Equipment Engineering Co., 210 S. Penna St., Indianapolis, Ind.; W. F. Hebard & Co., 551 W. Van Bren St., Chicago.

The Norton Co., Worcester, Mass., has appointed Crane-Schiefer-Owens, Inc., with offices in Buffalo, Syracuse and Rochester, N. Y., as representatives for the sale of Norton grinding, lapping and balancing machines. Offices of the representatives are at 210 Morgan Bldg., Buffalo; 425 Powers Bldg., Rochester, and 1602 State Tower Bldg., Syracuse.

Industrial Plants Corp. (Ohio), Huntington Bank Bldg., Columbus, Ohio, will sell at public auction on Feb. 21 the property of the Bucher & Gibbs Plow Co., 800 Second St., S.E., Canton, Ohio. The machinery and equipment includes: machine shop equipment, foundry equipment, blacksmith shop equipment, woodworking machinery and equipment, small tools and miscellaneous items.

Poole Foundry & Machine Co., Baltimore, Md., has appointed FRANK M. ESCH, Box 742, Houston, Texas, as direct representative for its line of flexible couplings and reduction gears.

The Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y., has been licensed by the Dardelet Threadlock Corp., New York, to manufacture and sell "Rivet-Bolts" and other bolts and nuts with the Dardlet self-locking thread.

Articles of incorporation have been filed by the Finnell Rotary Stokers, Inc., Elkhart, Ind., formed to manufacture coal stokers and other fuel handling equipment. The first board of directors is composed of GERALD MAHONEY, WILLIAM L. STUYVERSON and JAMES R. NYCE.

The Thomas Elevator Co., 20 S. Hoyne Ave., Chicago, Ill., manufacturer of electric, steam and gasoline hoists, has changed its name to The Thomas Hoist Co. No change has been made in the ownership, management or personnel.

• OBITUARIES •

KARL F. SNOW, a founder of C. O. Bartlett & Snow Co., Cleveland, died Jan. 30. Mr. Snow early exhibited a bent toward mechanics, and was taken in as a partner by C. O. Bartlett, who then owned a brick plant. After Bartlett & Snow was organized, it soon established a reputation as designers and makers of materials-handling equipment. Mr. Snow held a number of patents, most of them covering methods of handling chemicals, drying apparatus and conveyors.

FRANK E. SMITH, until last December president of Servel, Inc., and a prominent industrial engineer and financial counselor, died Feb. 8 in New York at the age of 55. At 21, he was manager of the Rhode Island Locomotive Works, later being associated with the American Locomotive Co., and the Rogers & Cooke Works in Paterson, N. J. He organized the plant of The Maxwell-Briscoe Motor Co. at New Castle, Ind., and in 1920 was president and general manager of the Republic Motor Truck Co.

WILLARD R. CARROLL, 61, a consulting engineer of the Farrell-Birmingham Co., Ansonia, Conn., died Feb. 3. Mr. Carroll was industrial engineer in rolling mills at Rome, N. Y., Waterbury, Conn., and Pittsburgh. During the war he was development engineer for the Derby Mfg. Co., Derby, Conn., and is said to have perfected several processes in the manufacture of machine parts.

JAMES H. FOOTE, president of the Metal Products Co., Cincinnati, Ohio, died Feb. 8.

JAMES PULLAR, Hartford, Conn., president of the James Pullar Co., automobile parts manufacturer, died Feb. 3.

ALFRED J. RUSSELL, president of Russell & Watson, Buffalo, manufacturers of metal kitchen equipment for restaurants, died Feb. 1.

CHARLES CLARK SHEPARD, one of the founders of the Ingalls-Shepard Forging Co., Harvey, Ill., and vice-president and treasurer for many years, died Feb. 3.

• MEETINGS •

AMERICAN SOCIETY FOR TESTING MATERIALS. Annual Spring group committee meetings. March 6-10. Fourth New York regional meeting. March 8. Both meetings at Hotel New Yorker, New York, N. Y. Thirty-sixth annual meeting, June 26-30. Chicago. C. L. WARWICK, secretary, 1315 Spruce St., Philadelphia, Pa.

AMERICAN WELDING SOCIETY. Annual meeting. April 27-28. New York, N. Y. Miss M. M. KELLY, secretary, 29 West 39th St., New York, N. Y.

CASE SCHOOL OF APPLIED SCIENCE AND THE CLEVELAND ENGINEERING SOCIETY. Joint conference on "Re-Engineering for Economical Manufacture." March 22-24. Case School of Applied Science, Cleveland, Ohio. PROF. E. S. AULT, chairman.

GRAY IRON INSTITUTE. Annual meeting. March 22. Hotel Cleveland, Cleveland, Ohio. ARTHUR J. TUSCANY, manager, 4300 Euclid Ave., Cleveland, Ohio.

• PERSONALS •

CHARLES E. WERTMAN has succeeded the late CLARENCE E. WHITNEY as president of the Whitney Mfg. Co., Hartford, Conn. Mr. Wertman has been connected with the Whitney company for 17 years, before that being associated with the Matheson Automobile Co. in an executive capacity, and earlier with the Packard Motor Car Co. in the production division. His machine shop experience was obtained at American Car & Foundry Co.

CHARLES S. DAVIS, president of the Borg-Warner Corp. and vice-president of the Warner Gear Co. of Muncie, Ind., was elected president of the Warner Gear Co. at a recent meeting of the directors to succeed the late RAY P. JOHNSON. J. M. SIMPSON, general manager, was promoted to the vice-presidency.

DAVID C. GRIGGS was re-elected president, Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., at its recent annual meeting. Other officers include R. L. WILCOX and Z. P. CANDEE, vice-presidents; W. D. PIERPONT, secretary; L. S. REED, treasurer; directors, E. A. ANDERSON, D. C. PIERSON, G. R. LAMB, W. S. FULTON and the above elected officers.

WILLIAM J. MEINEL, vice-president and general manager of the Heintz Mfg. Co., Philadelphia, maker of automobile bodies, radiators and stampings, was recently elected president to succeed FRANKLIN W. THACHER who became chairman of the board.

JOHN C. MYERS, vice-president of the F. E. Myers & Bros. Co., Ashland, Ohio, pump manufacturer, has been made president to succeed the late T. A. MYERS.

D. LAWRENCE CARLSON has been elected president and treasurer of the Lundell-Eckberg Mfg. Co., manufacturer of metal products, Jamestown, N. Y.

R. F. CARPENTER has been elected president and treasurer of the Carpenter Metal Products Co., Cleveland. He was formerly president of the Sanymetal Products Co.

FREDERICK C. BARR, production manager of the Harley-Davidson Motor Co., Milwaukee, has gone to Japan to investigate the practicability of building motorcycles in that country, which is an important user of such machines.

H. M. LUCAS, president of The Lucas Machine Tool Co., Cleveland, Ohio, has been re-elected president of the Associated Industries of Cleveland.

Another New Model

"Hello, Ed, sorry I'm late. I've been house-hunting. We're going to move in the spring."

"What's the matter, business increasing?"

"Not yet, but we've just finished redesigning our compressor and anticipate a demand that will justify moving into larger quarters. Come down to the shop sometime, Ed, and I'll show you something that will make your eyes stick out."

"What is it?"

"We've radically changed our compressor. Before, we had a cylinder that revolved with the rotor. Finally we woke up to the fact that we didn't need to revolve either one, and now we have a stationary cylinder and a rotor that doesn't 'rote.' "

"What are you going to do with the old design, Al?"

"We'll discontinue manufacturing it."

"Isn't that kind of unethical, Al?"

"What makes you say that?"

"It strikes me that it isn't entirely fair for a manufacturer to send his salesmen around one month selling what he claims is the last word and next month send the same salesman around to tell customers that the machines they bought the month before are out-of-date and not to be compared with the one the saleman is now selling."

"Well, someone has got to get the last old one. What would you do—make one design last forever?"

"No, but I'd leave a decent interval between the new and the old and give the customer a chance by telling him about the new one that is coming out."

"Maybe—but what would you do with the castings and any other material you had on hand that couldn't be used on the new machine?"

"Now you put your finger on the real cause of the practice. The manufacturer has so much material on hand that he is forced to delay selling the new model until he gets rid of the old ones."

"Sure, but what's the answer?"

"The answer is don't have so much excess material. When you know you are going to bring out a new model, cut your material to the limit. What won't balance, keep for repair parts."

"Suppose we did do that, Ed. How can we know that the new model will actually be better than the old one? Maybe we'd end up with having to continue the old. Then if we let our material run down, we'd be in a nice hole. You're a good foreman, Ed, and I used to be, but there's a lot about manufacturing that we didn't know about when we criticized our superiors so freely."

"Maybe, but if more knowledge on the subject of manufacturing is going to teach me that it is largely a confidence game, I don't want to know any more than I do."

"You use too strong a term, Ed. The only game is to give customers confidence in our product and show them that we are on the alert to make improvements. The fact that our new compressor is better and cheaper than our old one doesn't make the old one any less efficient, nor mean that we charged our customers too much for it. Our new one has no greater capacity, but requires less power and is easier to maintain. We're going to sell lots of them."

"It isn't right. When I buy a new machine I take pride in it because it represents the latest thing in its line. When a salesman comes around and tells me the machine he sold me a short time ago is obsolete, I'm through using his product. If you try the trick too often, it will be the same with your compressors."

Is there a difference between designing for sales effect and changing for increased efficiency? Is Al justified in bringing out a new model so soon?

Discussion

What's in a Name?

Hundreds of millions of dollars can't be wrong.

And that's the sum American commerce and industry has spent to keep its name before the public. That proves there must be something in a name. It doesn't matter what the name so long as it is connected with the product.

Very few know any of the Worthingtons but we all think of Worthington and pump as synonyms. Most of us, myself included, don't even know if there is anyone by the name of Worthington connected with the company. Elgin means watch to everyone. We don't know if the watch was named after the town, or if the town was named after the watch works. As long as we associate Elgin and watch that company's advertising has served its purpose.

Take Buick as an example. Buick as a car is well known to all. How many knew whether Mr. Buick was connected

with the organization? It was not until he died last year that people found out the original designer of Buick had been living. And he had not been connected with the auto company for years.

—Bernard Shereff,
Engineer, Standards Department,
American Hard Rubber Company.

Corporation or Partnership?

Under ordinary circumstances and times, a partnership is far the better of the two. It is conducted on a much more friendly scale. Each knows exactly how matters stand; they both have their entirety in their business; they learn to trust each other implicitly—and everything goes along splendidly.

However, the present isn't at all what one might call ordinary times. With nothing secure during this depression, a partnership is took weak a contract to compare with the rocklike solidity of the corporation. A corporation is a form of insurance for each member of the firm, in that he is not indebted for all that he owns personally, but merely for the amount of stock.

If a single individual of the partnership borrows or spends, both are forced to suffer the consequences. This is fair to neither member of the firm. After all, we don't mind being made to pay for what we ourselves do wrong, but we look at in an entirely different light when forced to pay for someone else's errors.

When any money is borrowed from the bank, the individual does not have to worry about placing his personal property up for security. He merely uses the stock which he holds in the firm as collateral. Of course, there must be some value behind the stock, but the same would be true of a partnership. If partnership in the business isn't worth anything why have the business?

—Will Herman,
Tanenbaum Oil Company.

No Mistakes

A small shop owner is justified in expecting more from an employee than is a corporation if he pays him more. That has nothing to do with the case of Al and Frazer, however.

Al is general manager and chief engineer, and Frazer is stock clerk, foreman, workman, inspector and road man. Frazer is overworked, and Al is loafing on the job.

As general manager it is Al's job to install an air-tight system. As chief engineer it is his job to furnish Frazer a clearly understandable bill of material.

At the same time Frazer is at fault. He was told twice of a change in design. He probably has fallen into sloppy ways of working because Al is a sloppy manager.

The real difficulty lies in the fact that there are too many functions for two men. Al is a good designer and Frazer is a good workman. There really is no general manager, stock clerk, foreman or inspector, and Al does not properly perform the functions of a chief engineer.

If Al gets as good a man as he expects, the man will be a better man than Al and should receive more money. In such a set-up, Al becomes salesman, designer and road man, while Frazer's successor becomes general manager, foreman, stock clerk and workman.

Taking it all in all, Frazer is as good a man as Al can expect to hire, until he improves considerably as a general manager. —Forrest E. Cardullo.

What has the small shop owner to offer an employee of the type that he seems to think he is entitled to? The employee of the smaller shop generally gets smaller wages, has less protection in times of stress, generally has no medical, vacation or many of the other advantages that the larger shops provide, and in addition is expected with poorer

tools to turn out work of a better quality than the corporation demands. In times like those we are now passing through the small shop proprietor can be "choosy" of his personnel but in times of good business should consider himself lucky to get fairly good help in competition with employers who can offer so much more to the workers. Even in the times now prevailing, Al is doing Frazer a good turn, as a man of the type that Frazer must be certainly will not be unemployed long.

—Charles R. Whitehouse,
Standards Engineer,
The Holtzer-Cabot Electric Company.

Al's comparison between a large shop and a small shop is wrong with the exception that with more men more mistakes may be made. Large shops realize that tools will wear, parts of machines will go out of adjustment, and that man-power is not infallible so they try to catch errors as soon as they are made and correct them. If Al will try to copy the large shop he can eliminate errors such as have just occurred.

A large shop does not have obsolete, broken, nor misfit pieces lying around the assembly floor ready for a man to pick up and place on a machine. In good shops such stuff is thrown on the scrap-pile. Al will do well to keep Frazer as he seems to be conscientious since he admitted the error.

—F. F. Anderson.

In an article under the above title (*AM*—Vol. 77, page 169), A. W. Forbes says in closing, "But there is no demand for this kind of training from the boys."

My case puts the shoe on the other foot.

After working on the assembly floor for some time, I asked the superintendent for a transfer either to the grinding department or the toolroom, stating as my reason that I was familiar with assembly and would like to learn something of the work in the other departments.

The answer, "If I had not needed more help on the assembly floor, you would still be tool boy in the lathe department."

At the end of my apprenticeship I did secure a transfer to the drilling department. They were short-handed.

If management would have the lads demand training, it must first offer a little of it. Then they will ask others to join; but as it stands at present in many shops, an apprentice asks an engineering student to enter the shop in order to get practical training, and is answered, "Yes, and get on the working end of a broom." —James A. Milne.

Borrowing from the Bank

Al's plan to borrow money from a bank when he does not need it is bad economics. The interest he would have to pay is a dead loss if he does not make use of the money he borrows. If he does use it, he is likely to use it more foolishly than if he needed it.

Al may be a good business man in his own line of business, but he cannot be expected to know as much about the banking business as the banker does.

If he is able to deceive the banker, may it not be possible that he himself may be equally deceived in his own business or by others? If Al's business is succeeding, he should let it expand naturally from its own profits and not be so anxious to hog it by over- expansion with other people's money.

The present period of depression with so many failures of banks and businesses is an object lesson which men of Al's type would do well to study and take to heart because that kind have so largely helped, by over-speeding, to throw the train of business off the track.

—L. Brown

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Basic Rack of the 14½ Deg Full Depth Involute System for Spur Gearing

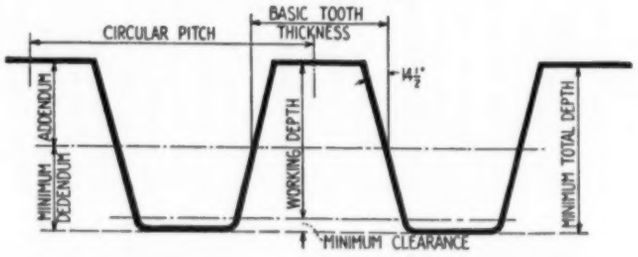


Table 1 Full Depth Tooth Proportions for Spur Gears

		In Terms of Diametral Pitch[1] (Inches)	In Terms of Circular Pitch[1] (Inches)
1.	Addendum	$= \frac{1}{DP}$	$0.3183 \times CP$
2.	Minimum Dedendum[2]	$= \frac{1.157}{DP}$	$0.3683 \times CP$
3.	Working Depth	$= \frac{2}{DP}$	$0.6366 \times CP$
4.	Minimum Total Depth[2]	$= \frac{2.157}{DP}$	$0.6866 \times CP$
5.	Pitch Diameter	$= \frac{N}{DP}$	$0.3183 \times N \times CP$
6.	Outside Diameter	$= \frac{N + 2}{DP}$	$0.3183 \times (N + 2) \times CP$
7.	Basic Tooth Thickness on Pitch Line	$= \frac{1.5708}{DP}$	$0.5 \times CP$
8.	Minimum Clearance[2,3]	$= \frac{0.157}{DP}$	$0.05 \times CP$
9.	Radius of Fillet	$= 1\frac{1}{3} \times$ Clearance	

N = Number of Teeth. DP = Diametral Pitch. CP = Circular Pitch.

[1] NOTE: The term Diametral Pitch is used up to 1 DP inclusive and the term Circular Pitch is used for 3 inches CP and over.

[2] NOTE: A suitable working tolerance should be considered in connection with all minimum recommendations.

[3] NOTE: Minimum clearance refers to the clearance between the top of the gear tooth, and the bottom of the mating gear space, and is specified as "minimum" so as to allow for necessary cutter clearance for all methods of producing gears. At the present time this value cannot be standardized.

Data for Use in Obtaining Full Involute Tooth Action on Pinions of 31 Teeth and Smaller, When Using the 14½ Deg Full Depth Involute System

To obtain full involute action when the pinion is in contact with a $14\frac{1}{2}$ deg basic rack, the outside diameter of the pinion must be increased. To maintain standard center distance where a gear is substituted for the rack, the outside diameter of the mating gear must be decreased the same amount.

Tabulations of the amounts of increase and decrease in diameter and the corresponding circular tooth thicknesses on the pitch line of both gear and pinion are included in the table below.

Long addendum pinions in mesh with standard addendum gears will run with full involute action, but it is self evident that in such cases, the center distance must be increased to suit the standard size gear.

If the sum of the numbers of teeth in the pinion and the mating gear is less than 64, undercutting will occur in the teeth of the mating gear.

Table 2 Diameter Increments,[1] Plus and Minus for 1 Diametral Pitch[2]

Number of Teeth in Pinion	Diameter[1] Increment	Pinion Circular Tooth Thickness	Mating Gear Circular Tooth Thickness	Min Number of Teeth in Mating Gear Avoiding Undercut	Min Number[3] of Teeth in Mating Gear for Full Involute Action
10	1.3731	1.9259	1.2157	54	27
11	1.3104	1.9097	1.2319	53	27
12	1.2477	1.8935	1.2481	52	26
13	1.1850	1.8773	1.2643	51	26
14	1.1223	1.8611	1.2805	50	26
15	1.0597	1.8449	1.2967	49	26
16	0.9970	1.8286	1.3130	48	26
17	0.9343	1.8124	1.3292	47	26
18	0.8716	1.7962	1.3454	46	26
19	0.8089	1.7800	1.3616	45	26
20	0.7462	1.7638	1.3778	44	26
21	0.6835	1.7476	1.3940	43	26
22	0.6208	1.7314	1.4102	42	27
23	0.5581	1.7151	1.4265	41	27
24	0.4954	1.6989	1.4427	40	27
25	0.4328	1.6827	1.4589	39	26
26	0.3701	1.6665	1.4751	38	26
27	0.3074	1.6503	1.4913	37	26
28	0.2447	1.6341	1.5075	36	25
29	0.1820	1.6179	1.5237	35	25
30	0.1193	1.6017	1.5399	34	24
31	0.0566	1.5854	1.5562	33	24

All dimensions in inches.

[1] NOTE: Diameter increment is the amount by which the outside diameter of the pinion must be increased over the standard outside diameter and also the amount by which the outside diameter of the mating gear must be decreased below standard to maintain standard center distances.

[2] NOTE: For other pitches divide values given by desired diametral pitch.

[3] NOTE: The number of gear teeth, in each case, shown in this column or any larger number of teeth, up to that specified in the preceding column, will produce undercutting of the gear teeth in varying amounts with consequent reduction in strength; the maximum undercutting in each case occurring with the minimum number of gear teeth.

Courtesy of American Standards Association

Standard sponsored by American Gear Manufacturers Association and The American Society of Mechanical Engineers.
Approved November, 1932. Material on 20-deg. spur gears will be published in the next number.

Adjustable Forming Die

JOHN W. GERDEL

Pans eight to twenty inches square were formed, including wire-rolling the edges, in this ingenious tool

A DIE, designed to fold the rectangular pan shown in Fig. 1 from a flat sheet, also does the work of wiring the edges and placing a false wire in each corner of the wired edges, with one stroke of the press. Another operation is required to complete the folding of the flaps at the corners which are left as illustrated.

The die was made with four corner assemblies so that any size pan from 8 to 20 in. square could be made by inserting spacers of the right size between them. The sectional and plan views in Fig. 2 show the position of the various parts of the die at the top of the stroke on the left side and at the bottom of the stroke at the right side.

Looking at the sectional view, the die was built between two bolting plates *A* and *B* which are about 30 in. square. The bottom plate was fastened to the bed of the press and the top plate was fastened to the under side of the ram. These plates were slotted to receive the feathers on the rails *C* and *D*. The rails were fastened to the bolting plates with screws through the slots as shown on the plan drawing.

The die plates *E* and *F* were slotted to receive the feather on the other side of the rails. The feathers on one side of the rails were put on lengthwise and on the other side crosswise. This arrangement permitted the corner assemblies to be located in any position from direct contact with each other to the limits of the rails and bolting plates.

At the left or open side of the sectional view is the forming block which is shaped like the inside of the corner of the pans. This block is free to move up and down for the distance that is required to make the wire edge. It is held in its upper position by a die spring and is held in place by the shouldered screw *G*.

The material from which these pans were made was ordinary hot rolled sheet. The thickness and temper varied so much that it was necessary to hold the forming blocks *H* in their upper position positively until the sheet was folded flat against the side of the block at the bottom. This was accomplished by placing an upright stud *J* in the lower die plate *E*. The stud was made of tool steel and had flats milled on its upper end. These flats were held in their proper position by a key in the bore in which the studs were placed.

The latch piece *K* was made of tool steel and had a flat milled on one end to correspond to the flat on the upright stud and was held in the latched position by means of a spring. These springs were backed up by plugs *L*. The flats on this latch piece were held in place by the push pin *M* which was made of drill rod. The inner end of this push pin rests in a recess in the latch piece which keeps the latter from turning.

The push pin is kept in place by a flat which has been milled on its side which fits around the upright stud *J* as shown on the plan view.

The forming blocks *H* have several slots milled in their sides at the lower end. Into these slots, tool steel pieces *N* were fitted which were screwed to the lower forming strip *O*. These pieces were placed there to keep the sheet metal from being forced between the forming blocks and the wire forming strips.

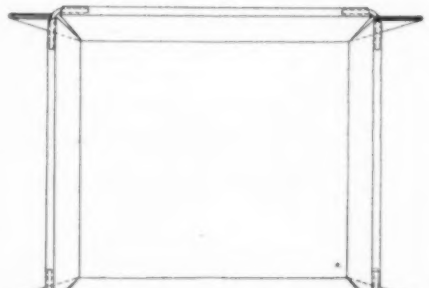


Fig. 1—A view of the pan after forming gives an idea of the problem of die design

The wire forming strips were held in place by the angle pieces *P* which were screwed and doweled to the lower die plate *F*. These angle pieces were also used to back up the lower end of the folding jaws *Q* to keep the sheet metal from forcing the folding jaw away from the block *H* when the wire edges were beginning to form.

The lower assembly was held together by the long filister head screws *R* and the dowel pins *S* as shown in the plan view.

The parallel sides of the forming blocks were made exactly 4 in. square. Therefore the smallest pan that could be made was 8 in. square inside the wired edges. The pans were ordered by this dimension so that it was only necessary to subtract 8 in. from the given dimensions of the pans to get the thickness of the spacers required. The spacers are marked *T*. The depth of the pans could not be changed with this device.

The upper assembly of the die consists of an anchor block *U* to which was hinged the folding jaws *Q*. These jaws were connected to the upper die block *E* by the link *V*. This link was shaped with a hump as shown on the sectional view. This hump was placed there to keep the folding jaw in the position as shown on the left side when the stroke of the press was at the top.

The folding jaw *Q* carried the upper wire forming strip *W* which was held in its outer position by springs. To this folding jaw was also fastened the tool steel strip *X* which took the wear when the sheet was folded. These strips also helped to form the slot in which the upper wire forming strips worked.

End movement of the upper wire forming strips was prevented on two sides of the die by dog-pointed screws as shown, and on the other sides of the die by the anvil blocks. These anvil

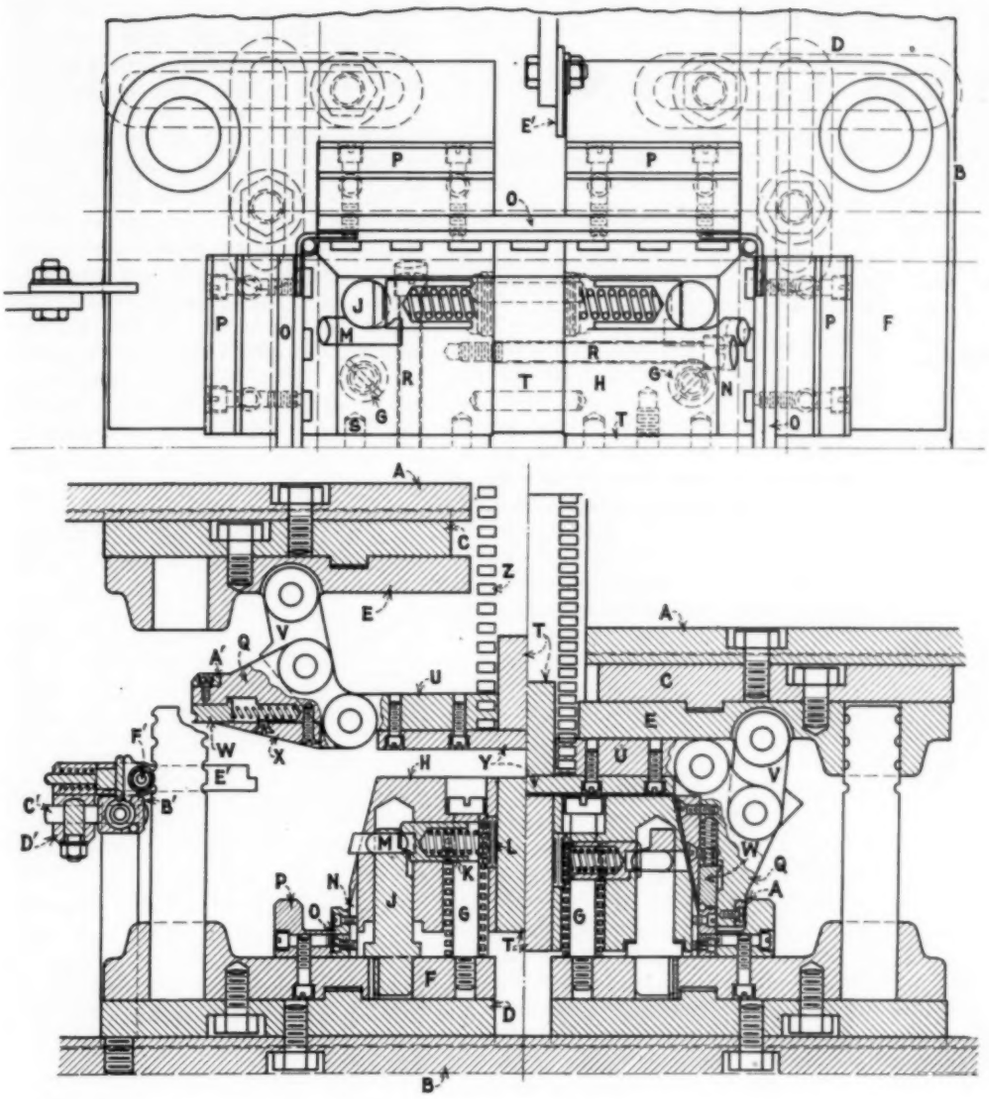


Fig. 2

On the left the die details are shown for the start of the stroke; on the right they are shown for the end of the stroke

blocks were also used to take the thrust of creasing the sheets at the corners.

The upper assemblies were held together by the sizing plate *Y* which was made the exact size of the bottom of the pan. The assemblies were fastened to the sizing plate by the anchor blocks *U* which were screwed and doweled to it.

A sizing plate *Y* had to be made for each size pan. To make the anchor blocks interchangeable with the several sizes of pans, the holes in the anchor block *U* and the holes on the corners of the sizing plates were located by means of jigs. As the holes in the sizing plate were located from its edges, it was necessary that it be exactly to size and square.

The sizing plate was held in the position as shown on the left side of the sectional drawing by a long and heavy spring *Z* which fitted in a recess in the ram. A strip of tool steel *A'* was fastened to the outer end of the folding jaws *Q* to take the wear when it slid into the angle pieces.

Each corner assembly was provided with a heavy leader pin so that when the four corner assemblies were fastened together there were four effective leader pins. As the edges of the sheets extended to only about one and a half inches inside of the travel of the end of the folding jaws, a gage as shown on the extreme left of the sectional view was devised.

A post was screwed into the bottom bolting plate on which was mounted the block *B'*. Into this block a shaft *C'* was fitted. On the other side of this shaft was a fixture *D'* which held a spring-operated stud. The gage piece *E'* was pivoted on this fixture at *F'*.

When the die descends, this gage piece is pushed down and out of the way by the folding jaw. These gages are placed in gaging position again by the operators when the press is at rest.

The sheets are cut to size on a slitter and the corners are chamfered on a square shear just enough so that there is not a double thickness of metal in the wired edges.

The die is operated by two operators. The corner wires are placed in the lower wire former strips where they are held in place by a spring holder as shown in Fig. 2. The sheet is then placed on top of the forming blocks and against the gages of which there are three. As the die descends, the sizing plate *Y* grasps the sheet.

The folding jaws then come into action, traveling until they have folded the sheet against the sides of the forming blocks *H*. This causes the push pin *M* to push the latch *K* off of the upright stud *J* which permits the forming blocks to travel the rest of the distance, causing the edges of the sheet to be formed into a false wire by being forced into the bottom wire former. When the sheet is folded against the sides of the forming blocks, the upper wire forming strips *X* hold the sheet flat against them so that the edges cannot do other than be formed into a wire edge. The upper wire former *W* travels back as the die descends, guiding the edge of the sheet around in a circle and then tucks the edge nicely home, making a neat job.

• IDEAS FROM PRACTICAL MEN

Bending Flat Springs

CHARLES KUGLER

On reading the article by A. Outwater under the title given above (*AM*—Vol. 76, page 796), I was reminded of a fixture used in a certain shop for bending flat springs in an arc. It was the practice in this shop to bend such springs in the fixture illustrated, and not to make press tools for the job unless the quantity wanted was very large. The reason was because there is no way to calculate what the amount of the spring back would be. It had to be found by experimenting with the tools themselves, the cost of which would be too great unless large quantities of the springs were required.

In the fixture illustrated, it is easy to make changes to permit finding the amount of spring back in the metal. If the radius of the arc of the spring produced is too long, the diameter of the stud *A* can be reduced by turning off a little at a time, making a trial spring between each reduction. If the radius is too short, the stud can be replaced by one of larger diameter. The lever *B* is slotted so that the roller *C* can be adjusted to suit studs of different diameters.

On one occasion, after finding the correct diameter of the stud *A* for a certain spring, press tools were made to the same radius as that of the stud, but much to the surprise of all, the springs produced by the tools had an arc of longer radius than that of the spring formed in the fixture. I believe this difference was due to the difference in the methods of bending the springs. In the ones bent in the fixture, the metal was ironed into shape, while in the ones made in the press, the metal was formed to shape by pressure in one direction.

Press Tools for Bending Tubing

FRANK H. STRAN

We had a large quantity of short lengths of tubing to bend to an angle of 90 deg., as shown at *A* in the illustration, without marring the threads at the ends. Deciding to do the bending in a press, we made the tools illustrated.

The die-blocks *B* and *C* are segments of circles having half-round grooves in the flats of the same radius as that of the outside of the tubing to be bent. Both die-blocks are rotatably seated in circular pockets in the die-shoe and are held against the stop pins *D* and *E* in the position shown by springs. The punch is grooved to match the die-blocks and its included angle is slightly less than 90 deg. to allow for the spring-back of the tubing after it has been bent.

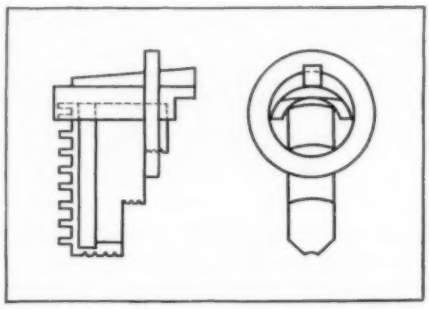
The tubing is laid on the flat parts of the die-blocks, as shown in Fig. 1. When the punch descends and contacts with the tubing, the die-blocks rotate in their seats to the positions shown in Fig. 2, and the tubing is bent to a right angle. As the punch ascends the springs rotate the die-blocks in the opposite direction, bringing them to their former positions. The half-round grooves in the die-blocks and in the punch protect the thread at the short end from injury.

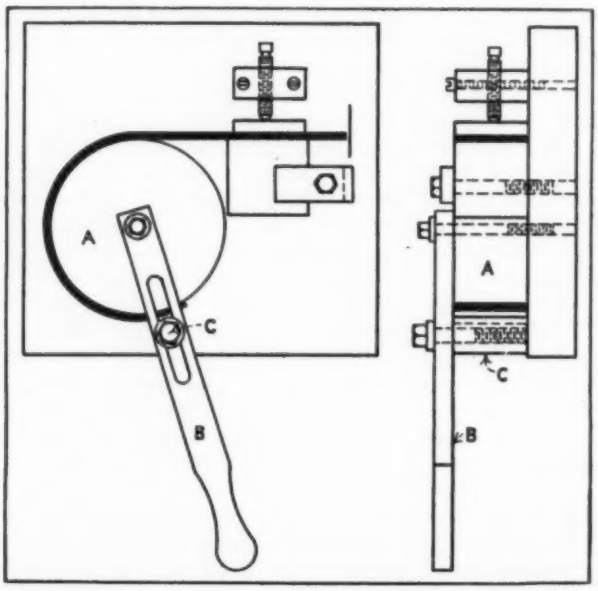
Increasing the Capacity of a Lathe Chuck

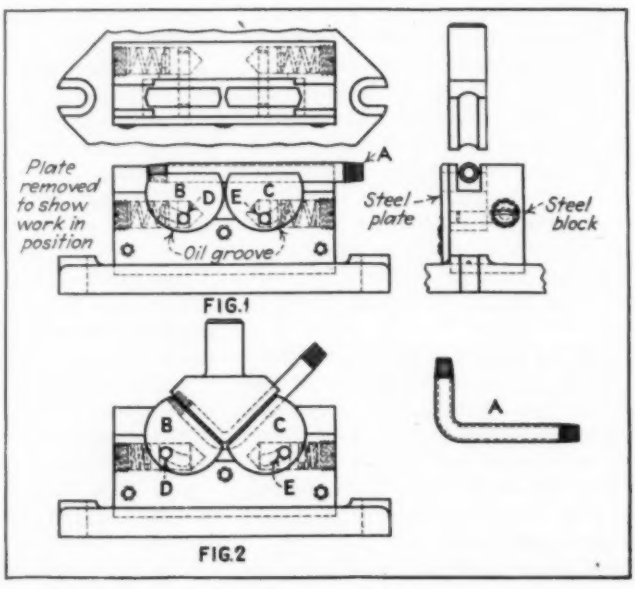
DEXTER W. ALLIS

We had to do some work on disks that were too large in diameter to be held in the only available lathe chuck. The work was held, however, by means of an additional step clamped to the outer extremity of each chuck jaw in the manner shown.

A piece of halved pipe, forming the extra step, was held firmly against the







outermost part of each jaw by a wedge driven between the pipe and a washer that was bored out to act as a retaining ring. It will be seen by the illustration that the overhanging part of the step, formed by turning away the metal beneath, is reinforced by the metal wedge driven in above it.

Press Tools for Escutcheon Plates—*Discussion*

A. EYLES
Manchester, England

After reading the article by C. W. Hinman, under the title given above (*AM*—Vol. 76, page 1038), I was prompted to describe briefly the layout of progressive tools recently designed in our plant for producing large quantities of escutcheon plates, such as the one shown in Fig. 1. These plates are used in connection with private locks on the doors of passenger cars and are made from 20-gage (0.036-in.) cold-rolled brass strip stock 1½ in. wide, the composition of which is 66 per cent copper and 34 per cent zinc.

In operation, the tools shown in Fig. 2 are mounted in an inclined press, the stock being fed from a reel by feed rolls, passing through the guide slot *A* to the piercing punches. When the ram descends, the three round holes are pierced. On the up stroke of the ram, the stock is fed forward through guides in the plate *B*, coming to rest between the blanking and forming tools. At the next descent of the ram, the piece is blanked and formed, and the stock at the left is pierced. Thereafter, one piece is produced at each stroke.

In forming the piece, the spring plunger *C* is forced downward, compressing the spring. On the up stroke of the ram, the spring-loaded stripper *D* ejects the piece from the forming die, from which it slides down a chute and into a receptacle at the rear. The press runs continuously at 100 strokes per min., and the production is 6,000 pieces per hr. The weight of 1,000 pieces is 20 lb., approximately.

Automatic Feeding Fixture for Milling Slots

L. L. LOCKE

In the illustration is shown a fixture for automatically feeding studs, such as the one at *A*, for milling slots in the heads. The fixture is used in a small, knee-type milling machine and is driven from the feed shaft that is ordinarily connected to the feed gear of the table. No table feed is necessary, since the fixture remains in a fixed position in relation to the machine spindle.

Power to the feeding sprocket *B* is transferred from the drive shaft through miter gears, shafts and worm gearing. The wormwheel *C* is mounted on a vertical shaft that carries the feeding sprocket on its upper end. The work is loaded into the feeding sprocket with the heads down on the plate *D*. As the sprocket revolves, the work is fed through the slotted guide *F* and is carried over the cutter, the finished pieces dropping out of the fixture at *H* into a tote box.

To prevent chatter, the studs are held with their upper ends against the guide by the spring-actuated plate *I*, which is hinged to the under side of the guide and is slotted to provide clearance for the cutter. Since the studs are over the cutter, the chips fall clear of them and they slide out of the guide comparatively clean. A fixture of this kind can be used for slotting many small, round parts, especially where a large output is called for. For the operation described, the production is 1,200 per hr. The material is SAE 1020 steel.

A Profiling Fixture

DUDLEY L. CURTIS

In the illustration is shown a fixture designed for profiling strips of fiber. It can be used in a vertical milling machine, or in a horizontal one equipped with a vertical milling attachment. Four strips of fiber are stacked on the slide and held down by clamps, location being from the rear edge and one end.

The slide is actuated by stationary cam attached to the end adjacent to the machine column and is kept in contact with the cam roller by three coil springs, the cam roller being mounted on a bracket attached to the machine column. As the machine table is traversed, the slide moves back and forth, following the path of the cam. Since the slide is much wider than its length, some means are necessary to prevent it from binding.

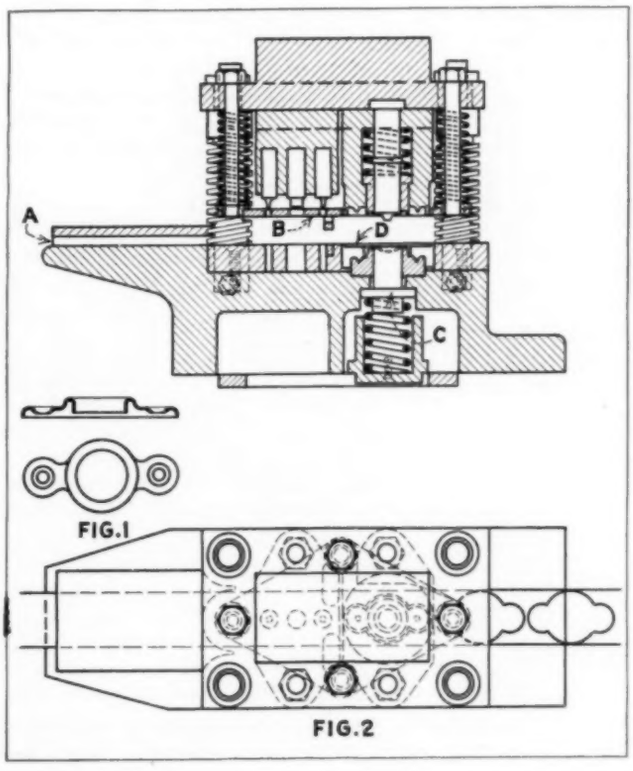
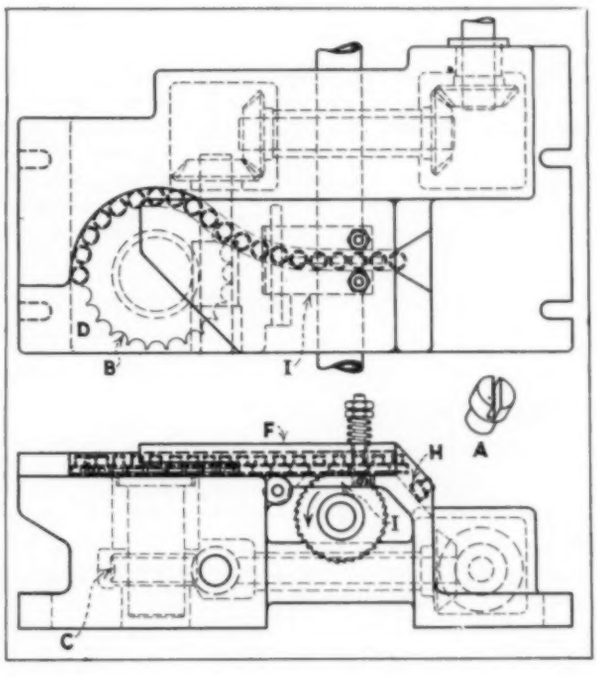
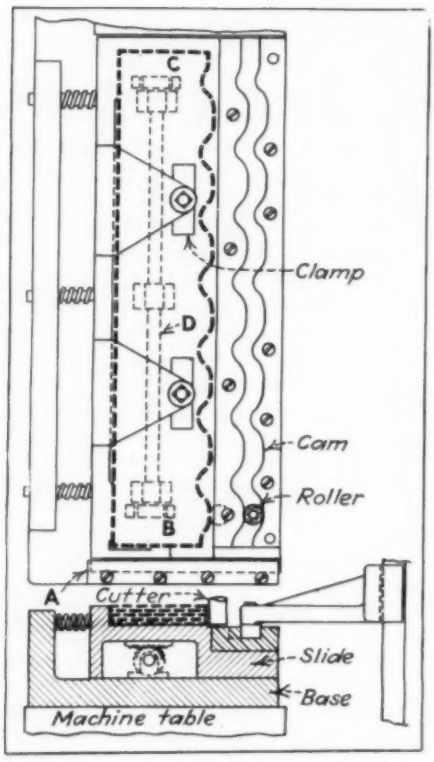


FIG. 1

FIG. 2





Construction details of vise and guiding mechanism for profile milling

It is guided in the base by two tongues fitting in slots, and by the plates *A* at the sides, which also hold it down. In addition, racks and pinions are provided at *B* and *C*, the pinions being keyed to the shaft *D*. The racks and the pinions equalize the pressure required to move the slide, so that there is no tendency for it to bind.

Cost-Cutting Press Tools

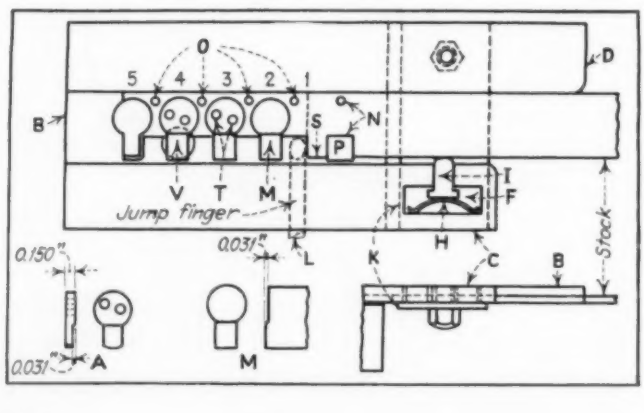
CHARLES F. KRAUT

Large quantities of the product shown at *A* in the illustration were formerly pierced and blanked and then the 0.031-in. step was machined by an end mill operated in a drill press, the work being held in a suitable fixture. To eliminate the milling, the tools illustrated were designed so that the 0.031-in. step was swaged in one of the operations.

Referring to the illustration, *B* is the die, *C* and *D* are the side gages. The side gage *C* has an opening at *F* for the reception of the spring *H* and the tension plate *I*, both of which are supported by the plate *K*, which is clamped to the underside of side gage *C*. The stripper plate (not shown) is extended to cover the spring and the tension plate. The dotted lines at *L* indicate the position of the jump-finger stop, which is held in the stripper and is operated in the conventional manner. The face of the swaging punch and a partial side view of the blanking punch are shown at *M*. The leader pins (not shown) are held in the punch-holder and are guided by bushings in the stripper. They are longer than the cutting tools, so as to enter the holes in the stock and position it before cutting begins.

In operation, the stock is fed to the left until it rests against the jump-finger stop and is held parallel with the side gage *C* by the tension plate and the spring, and in accurate alignment with the pierced hole *N* and the leader-pin holes *O*. As the ram descends, one leader-pin hole is pierced and the rectangular notch *P* is clipped in the side of the stock, producing the first prong *S*. The stock is then advanced and the jump finger drops into the notch, spacing the stock for the next operation.

As the ram descends at station 2, the punch *M* swages the prong *S* and levels the stock, the face of the die acting as an anvil. When the stock is advanced to station 3, the two holes *T* are pierced. At station 4, the under side of the prong in the potential blank is stamped with the date of patent by a stamp inserted in the die at *V*, the prong being struck by a stepped punch that is a duplicate of the swaging punch. At station 5, a partial blank is cut from the end of the stock. At the next advance of the stock, a full blank is produced at station 5, and thereafter one full blank is produced at each stroke of the ram, the bulges on the prongs being trimmed off at this station.



General layout of press tools for a special punching and swaging job which greatly reduced costs by eliminating a milling operation

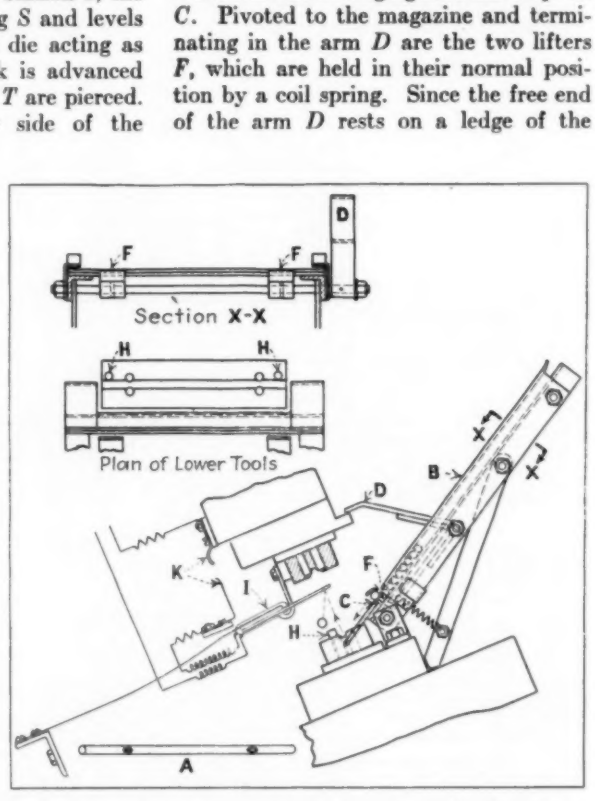
Automatic Feed and Ejection for Press Tools

J. F. CAVANAGH
Boston Wire Stitcher Company

While the electromagnet offers a solution to many little problems in production, it is not utilized nearly so much as its merits warrant. Its application for the ejection of finished work from a press is shown in the illustration as a part of the automatic equipment.

The finished product, indicated at *A*, is a wrought-iron rod about 6 in. long on which two sets of ears have been "pinched" from the body, the ears in each set being diametrically opposite to one another. The work is done in an inclined press to facilitate removal of the finished parts.

Referring to the illustration, the inclined magazine *B* holds about 24 rods, the lower one resting against the stops at *C*. Pivoted to the magazine and terminating in the arm *D* are the two lifters *F*, which are held in their normal position by a coil spring. Since the free end of the arm *D* rests on a ledge of the



Using an electromagnet to simplify mechanism for feeding and ejecting work from the punch press

punch plate, the lifters are operated by the ram. As the ram ascends, the lower rod in the magazine is raised above the stops at *C* by the lifters and rolls down the incline against the pins *H*, when it falls into the half-round groove in the lower tool member. When the ram descends, the punches in both tool members form the ears by pinching. At the same time, the lifters are returned to their normal position by the spring and the rods in the magazine roll down until the lower one rests against the stop pins at the bottom.

At *I* is an electromagnet having a flat core and mounted on flat bars of spring brass attached to brackets. Extensions of the core reach over the half-round groove in the lower tool member, the magnet itself being supported by a hook attached to the punch-holder. The magnet is in a 100-v d.c. circuit in which the flow is established and broken by the contacts *K*, one of which is attached to the ram, while the other is attached to a stationary part of the press, both, of course, being mounted on insulating blocks. As the ram descends, electrical contact is made by the pieces *K* and the core of the magnet and its extensions energized. At the bottom of the stroke, the core extensions, being lowered with the magnet, contact with the finished work. As the ram ascends, the work is lifted up by magnetic attraction and is let drop when electrical contact is broken by further ascent of the ram. When the work drops, it rolls down the inclined bed of the press and falls into a receptacle at the rear.

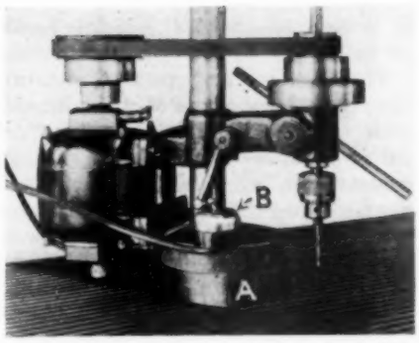
This arrangement worked very satisfactorily at 125 press strokes per min. and earned excellent returns for the expenditure involved. It simply requires the magazine to be kept filled by an unskilled hand, entailing no physical hazards on his part.

Holding Portable Drills by Electromagnets

JOHN STEINER
Steiner Brothers, Incorporated

The drilling of approximately 800 ⅛-in. holes in a steel plate 31 in. wide and 6 ft. long presented considerable difficulty. The largest of our drill presses had not enough room between the column and the center of the spindle for the drill to reach the center of the plate. Even had we had a large enough drill press, considerable time would have been wasted in adjusting the 400-lb. plate from hole to hole and in supporting the overhanging end.

However, we had several small portable drill presses equipped with d.c. motors that we could use provided we could find some easy way of clamping



Making a small portable drill do the work of a long arm radial

their bases to the plate. Finally, we decided to mount the drill presses on electromagnets, one so mounted being shown in the illustration, where *A* is the electromagnet and *B* is the switch. Having d.c. equipment in our factory for the magnetic chucks on our surface grinders, it was merely a matter of plugging into the line to make the connection.

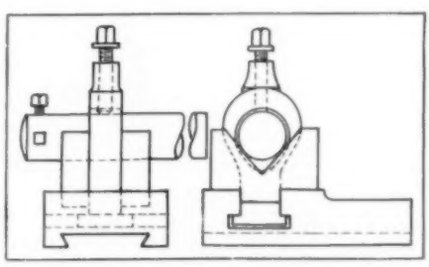
After a hole had been drilled, the current was cut off by the switch, de-energizing the electromagnet, and the drill press was moved into position for the next hole, where it was held by switching on the current and energizing the electromagnet. By the use of several of the portable drill presses the drilling was done in record time.

A Handy Holder for Boring Tools

H. H. HENSON
Foreman, Machine Shop
Southern Railway Co.

While there are various types of holders for boring tools, many of them have some drawback that makes them troublesome, if not inefficient. The holder illustrated holds the toolbar rigidly and will not permit it to be swung around by pressure of the cut.

The toolbar is slipped through the special toolpost and rests in V-blocks on each side, the bottoms of the V-blocks being tongued to fit the upper part of the T-slot in the toolblock. Toolbars of various sizes can be used. Since the special toolpost is tapped for the regular toolpost screw, no other screw is needed to hold the toolbar in place.

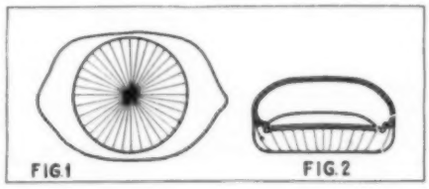


Finding the Size and Shape of Blanks for Irregular Shells

CHARLES WESLOW

Many a diemaker is baffled in finding the correct size and shape of the blank for drawing a shell of irregular shape. I know of no other method than by trial and error, but I have a method by which the error can be located pretty accurately, saving considerable time. I make two or three blanks and try them out, correcting the errors as best I can. Then I make two blanks, both alike, and from the approximate centers I scribe a circle on each and divide it into a convenient number of parts, scribing radial lines to the edge, as shown in Fig. 1. The radial lines are so spaced as to be about ⅛ in. apart at the edge of a blank of 1 sq.in. in area, and ¼ in. apart in a blank of 4 sq.in. in area.

One of the scribed blanks is put into



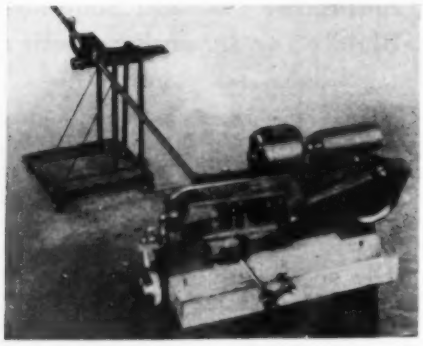
the press and is drawn so that the scribed lines are on the outside, as shown in Fig. 2. At any part of the edge can be seen where there is either too much or too little metal. The spaces between the lines where there is metal to be removed or added can easily be counted. It is then a simple matter to scribe the second blank where there is a surplus of metal and to remove the surplus by filing. If the blank has not enough metal, two more blanks can be made, laying them out as before. When one of these blanks has been drawn and the other one has been corrected according to the error shown, a blank of the correct size and shape can be easily determined.

In the shell shown in Fig. 2 it will be noticed that there is apparently too much metal on one side and not enough on the other. This error was not the fault of the blank, but was caused by the adjustable nest not being in the right place on the drawing die.

A Bar Support for the Hack Saw

LAWRENCE F. ASHLEY
Eastern Illinois State Teachers College

A very convenient support for the outboard ends of bars to be cut in the power hacksaw is shown in the illustration. It consists of a metal stand mounted on four casters, so that it can



Portable vise stand for supporting end of bars being cut by hacksaw

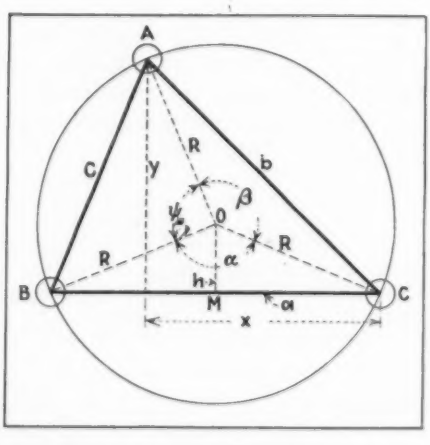
readily be moved to any desired position. The stand is equipped with a quick-acting vise, which is the same height from the floor as is the vise on the machine. The device is of welded construction and can be built in any welding shop at small cost. This support is in use in the Eastern Illinois State Teachers College, where it was built by the writer.

Formulas for Operators of Jig Boring Machines

WILLIAM W. JOHNSON

When locating holes to be bored in a jig boring machine, a problem of frequent occurrence is the one in which it is required to determine the coordinates of a point that is at certain given distances from two fixed points, as in locating the center of an idler gear where the centers of the driver and the driven gear are already fixed, or to determine the location of the center of a circle that will pass through three given points.

To simplify the set-up on the jig boring machine, it is advisable to locate two of the centers on the line of travel of either of the work-table slides. The accompanying diagram indicates the location of three holes, A, B and C with reference to the center O of the circular table, or to the line B-C, which is parallel to the line of travel of either slide.



How work is laid out to help operators of jig boring machines

The formulas may be applied when spacing holes by means of either the circular table or the table cross-slide. All the formulas are adapted to logarithmic computation, and therefore have an advantage when the known dimensions are given in three or more figures. In practice, formulas A, B and C may be used independently to suit the means employed for spacing the holes. In the illustration, the center O of the circle lies in the perpendicular erected from the middle of one of the sides.

By geometry,

angle $BOC = 2A$

$a = 2R \sin A$

Therefore

$$R = \frac{a}{2 \sin A} = \frac{b}{2 \sin B} = \frac{c}{2 \sin C}$$

Writing these in the form

$$\frac{a}{2} = R \sin A$$

$$\frac{b}{2} = R \sin B$$

$$\frac{c}{2} = R \sin C$$

Adding, we get

$$\frac{a+b+c}{2} = R(\sin A + \sin B + \sin C) \quad (1)$$

By trigonometry,

$$\sin A + \sin B + \sin C = 4 \cos \frac{A}{2} \cos \frac{B}{2} \cos \frac{C}{2}$$

Let

$$\frac{a+b+c}{2} = s$$

Then from (1), we get

$$R = \frac{s}{4 \cos \frac{A}{2} \cos \frac{B}{2} \cos \frac{C}{2}} \quad (2)$$

Again by trigonometry,

$$4 \cos \frac{A}{2} \cos \frac{B}{2} \cos \frac{C}{2} = \frac{4s\sqrt{s(s-a)(s-b)(s-c)}}{abc}$$

Then from (2), we get

$$R = \frac{abc}{4\sqrt{s(s-a)(s-b)(s-c)}} \quad (A)$$

By trigonometry

$$\left.\begin{aligned} \sin \frac{\alpha}{2} &= \frac{2}{bc}\sqrt{s(s-a)(s-b)(s-c)} \\ \sin \frac{\beta}{2} &= \frac{2}{ac}\sqrt{s(s-a(s-b)(s-c)} \\ \sin \frac{\Psi}{2} &= \frac{2}{ab}\sqrt{s(s-a)(s-b)(s-c)} \end{aligned}\right\} \quad (B)$$

$$OM = h = R \cos \frac{\alpha}{2} \quad (C)$$

$$y = \frac{2}{a}\sqrt{s(s-a)(s-b)(s-c)} \quad (D)$$

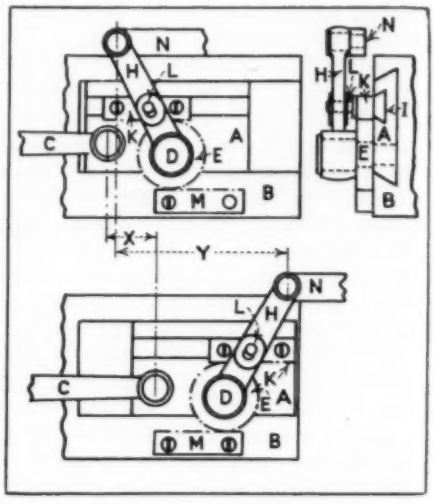
$$x = \sqrt{b^2 - y^2} = \sqrt{(b+y)(b-y)} \quad (E)$$

A Compact Lever Motion

R. H. KASPER

In the illustration is shown a device in which the movement of one rod is transmitted to another in increased ratio in a compact space.

Referring to the illustration, the dovetailed slide A is caused to move back and forth in the stationary part B, receiving its motion from the connecting rod C. Slide A carries the stud D, on which is mounted the gear E and the lever H, both of which rotate independently of each other. Slide A also carries



A method of using increasing ratio levers in a small space

the dovetailed slide I to which is attached the rack K and the pin L. Rack K is in mesh with gear E, and the pin L engages a slot in lever H. The rack M is immovably attached to the stationary part B and is also in mesh with gear E. Lever H transmits motion to the rod N to which it is pivoted.

In the upper view, the connecting rod C is beginning its movement to the right, transmitting a like movement to the slide A. Since the gear E is in mesh with both racks, its rotation causes rack K to move in the same direction. As the gear is virtually a third-class lever having equal arms, the linear movement of rack K is double that of the slide A and the stud D, and this multiplied movement is transmitted to lever H through the pin L. The amount of linear movement of slide A is indicated by X, while the amount of movement of the rod N is indicated by Y, showing

the multiplication of movement, which is accomplished in a compact space and without the aid of a long lever.

Since the stud *D* moves with the slide *A*, the outer end of lever H does not describe a true arc, the curve resembling the long side of an ellipse. Thus the motion transmitted to the rod *N* is at a more nearly uniform velocity than if the stud *D* were fixed. The movement is also accomplished with less angularity between the extreme positions of lever *H*, the angularity being approximately 57 deg. With direct linkage and with the lever *H* of the same length, the angularity would be approximately 92 deg. As the connecting rod *C* is not directly connected to lever *H*, its relative position to that of rod *N* is unrestricted, as it may be pivoted to the slide *A* at any point without changing the results.

Equipment for Profile Turning

D. L. BROWN

Turning taper drive shafts of special steel for automobile trucks is a job for special equipment on heavy-duty lathes, especially if modern production is to be maintained.

The lathe illustrated in Fig. 1 has hydraulic feed and is equipped with a floating driver *A* and a cam-controlled toolhead *B*. The rough shaft *C* is held between centers and is driven by serrated jaws in the floating driver. A single roughing cut removes all except grinding stock from the shaft, the ends of which are finish turned and splined in later operations.

The cam, or former, *D* is practically a duplicate of the desired profile of the shaft. The follower *E*, bearing on the former and directly connected to one of the toolblocks, reproduces every rise and drop in the former with an equal and corresponding decrease in the radius of the shaft. The collapsible contact block *H* is mounted in the follower, its normal working position being shown at *I*. The return traverse of the toolhead causes the contact block to collapse, as shown at *K*, permitting the tools to open up and clear the work. It is understood that the former and the contact block are hardened and ground. Excessive pressure of the sliding parts is avoided by the construction of the toolhead and the grinding of the tools. When properly ground, the tendency of the tangential type of tools is to open up the toolblocks, thereby maintaining contact between the contact block and the former without the use of springs.

In Fig. 2 are the details of the toolhead and its connection to the former. The bracket *A* supports the former *D* at the rear of the lathe. The follower *E*, directly connected to the rear toolblock, which slides in the head, carries a rack similar to the racks *L* attached to the other two toolblocks. These racks mesh with the three pinions *M*, which are integral with the shafts *N*. At the other ends of these shafts are the duplicate pinions *O* meshing with the internal gear *P*. Thus the movement of the rear toolblock imparts a like movement to the other two toolblocks. It will be noted that all three tools *S* move in a sraight line tangent to the work. The tools are dovetailed to fit the toolblocks and are firmly held by setscrews, an adjusting screw being provided for each tool.

Referring to Fig. 3, the driver *A* carries the dovetailed floating member *B*, which is held within normal sliding limits by the studs *C*. The two pivoted jaws *D* are serrated to firmly grip the work. If the shaft does not run true, the floating driver adjusts itself automatically and any tendency for the jaws to slip merely causes them to grip the work tighter. The springs *E* serve to equalize the movement of the jaws and prevent them from slipping. For work of different diameters, other jaws can be used.

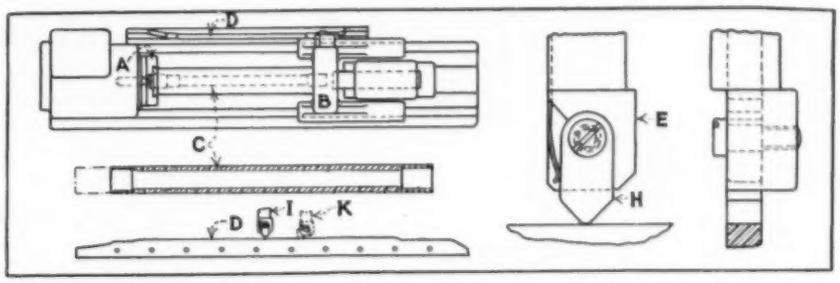


Fig. 1—General plan of lathe and cam for profile turning

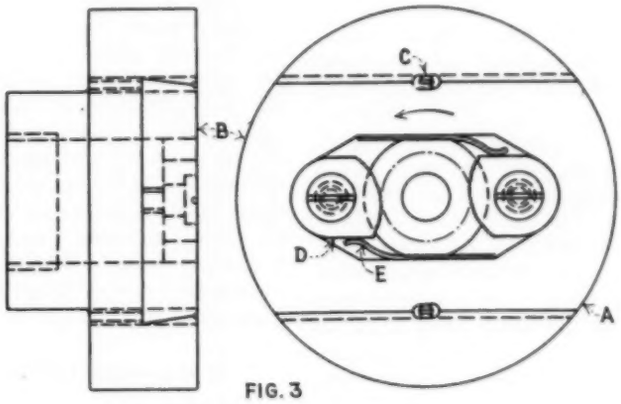


FIG. 3

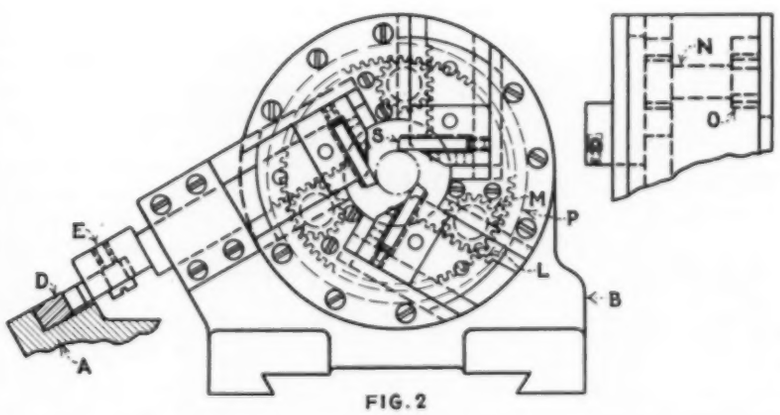


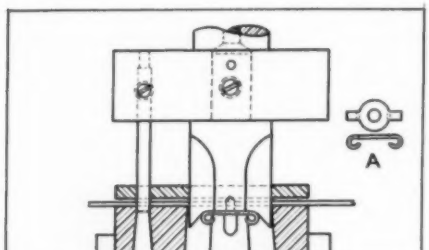
FIG. 2

Figs. 2 and 3—Details of the toolhead and driver, showing contact with cam. Movement of one tool is transmitted to others by internal gears and pinions

Combined Forming and Blanking Punch

E. F. EBERHARD

An example of economy as practiced in one diemaking department is shown in the tools illustrated. The part to be made is a double spring-hook for a toy locomotive and is shown at *A*. The round hole is pierced at the first station, and at the second station the wings on each side of the combined forming and blanking punch shear and curl the ends of the piece, partly blanking it. By the time the curls are fully formed, the punch



Punching, shearing and curling at a single stroke of the press

fully blanks the piece, all the work being done at the one stroke. This unusual feature of the blanking punch reduced the cost of the tools and simplified their design. Otherwise, an extra station for the forming would have been required.

In making this punch, the angle of the wings was determined by trial. At first, the angle was extremely sharp and was gradually changed until the desired curl was obtained. The distance between the stations was made slightly greater than the length of the blank when flattened out, so as to permit both shearing points of the punch to enter the solid stock, and also to prevent any floating of the strip, which would result in unequal curls at the ends of the blank.

It is obvious that the principle of this punch can be applied to a punch where the part to be made is more intricate in shape than is the part in question.

SEEN AND HEARD

JOHN R. GODFREY

Reversing the Shrink Process

Several years ago I ran across a bright shop man who wanted to shrink valve seats into aluminum cylinder heads. He couldn't heat the heads on account of distortion, as they were of varying section, so he got the bright idea of freezing the valve seats with liquid air and letting them expand into place, which worked perfectly. Now the liquid air people are doing this sort of thing in several lines and have equipment especially designed for it. It's a slick proposition for many kinds of work, and ought to find a place in many industries.

Pipe Bends and Lamp Filaments

Years ago we used to fill tubes to be bent with melted resin. Then, after bending, we melted the resin and let it run out. The same notion is being used today in making tungsten filament wire for electric lamps. The filament is wound on brass or iron wire as a mandrel. Then both coil and mandrel are put in an acid bath that eats out the mandrel without impairing the delicate tungsten coils. The main difference is that the resin was a crude operation while the etching process demands microscopic refinement.

Keeping Oil Clean

Lubrication has long been recognized as a very important factor in machine operation. But as Mark Twain said about the weather, "we talk about it and complain at it but no one does much of anything." Of course we have made advances in lubrication. We've put miles of copper pipe on machines to shoot grease into inaccessible bearings but the grease gun too often gets grit in it because of carelessness along the line. We put on flossy pumping systems to insure oil getting where it should, but we don't always know that nothing but clean oil ever gets in the system. It doesn't take much grit in oil to play hob with a bearing, so while a plentiful supply is highly desirable, we should be very fussy about having it clean.

Reclaiming Cutting Oils

Conservation is being extended to cutting oils—or at least it is being considered by at least one large concern. The problem is being attacked from two angles: to reclaim the oil from the whole solution, as it comes from the machines; or to separate the oil from water by centrifugal machine and then reclaim the oil in the same way as the large bus companies handle their motor lubricating oil. If anyone can shed light on this subject it will be welcomed by at least one research engineer of my acquaintance.

Stellite Inserts Increase Life of Parts

Years ago chilled cast iron was the hardest metal we knew. Now we have such alloys as Stellite, for which new applications are being found frequently. At least one gas motor builder is using Stellite inserts in his valve seats and so eliminating all valve grinding. A new valve wears out perhaps after 50,000 to 100,000 miles, but the valve seat is there for keeps. Now come Stellite inserts in collet jaws which increase their life to an almost unbelievable point. Where hardened steel collet jaws wore out in 14 hr., jaws with Stellite inserts run from 1,000 to 2,000 hr. With results like these, first cost loses much of its significance, as both increased life and the saving in down time for repairs are worth real money.

Where Alloys Help

Discoveries along the line of alloys are of more value than we sometimes realize. Indicating and recording instruments, particularly thermometers, are an excellent case where alloys have special significance. Industrial thermometers that must be sensitive are made with mercury inserted between the bulb and the sheath which protects it, ordinarily called the bulb chamber. Trouble has been experienced with some thermometers in the past because this chamber, made of steel and copperplated on the outside, was not sufficiently protected against corrosion. Now one maker at least is using monel metal for bulb chambers, and the trouble has disappeared.

Repair Parts by Airplane

Machine breakdowns are furnishing an appreciable part of the shipments by air express. Which again emphasizes the importance of the machine. Breaking even an insignificant part of a machine may tie up all production until it can be replaced. Now a telegram to the factory, followed by shipment by air, reduces the delay to a small fraction of the time formerly required. Incidentally this decrease in delivery time may make it unnecessary to carry stocks of spare parts at many points, just as improved railway service has made it possible for dealers generally to carry smaller stocks than formerly.

Sealing Solution for Castings

Often brass, nickel and other casting to be used on liquid resistant work must be considered total losses by foundrymen because they sweat or leak. Water-glass, shellac, and other solutions have been used, but none have proved especially lasting. Now the Bakelite Corporation has developed a sealing solution which is forced into the pores of the casting, then baked in an oven. The resulting seal is unaffected by hot or cold water, by steam, or by temperatures up to 400 deg. F. It is resistant to most chemical reagents.

SHOP EQUIPMENT NEWS

Bullard Type "F" Twin Six-Spindle Mult-Au-Matic

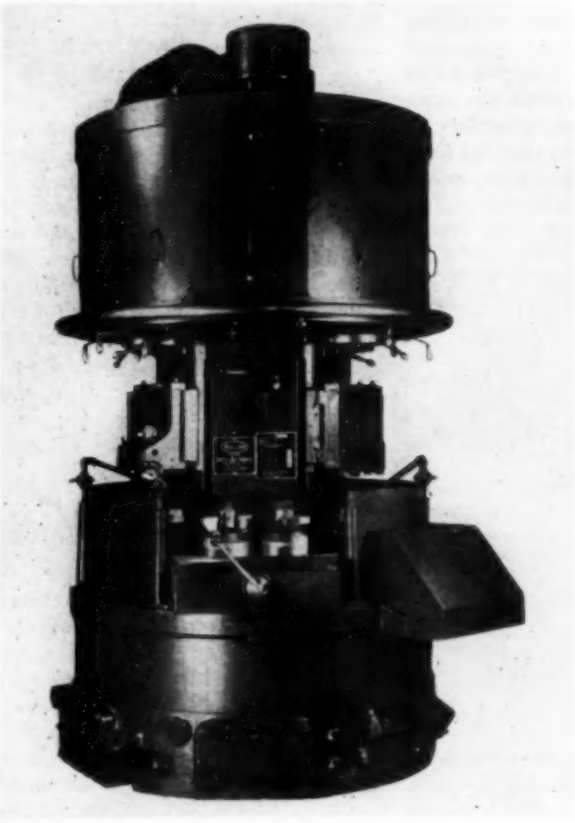
Provided with two 7-in. chucks at each of the six stations, the Type "F" twin-six Mult-Au-Matic is intended for greater production on the smaller classes of work. Offered by the Bullard Co., Bridgeport, Conn., the Type F can be had in either a high or low speed model. By means of change gears, the high speed model gives speeds from 112 to 1,008 r.p.m. and feed changes from 0.0031 to 0.0281 in. Speed range for the low-speed model is from 46 to 417 r.p.m. by means of change gears, and the feed changes range from 0.0075 to 0.0678 in.

Two spindles are provided at each of the six stations, making a total of twelve spindles. Duplicate tooling performs identical operations on work in each of the twin chucks, thereby doubling the productive output from one machine at only a slightly greater investment. The machine may be obtained with double indexing for the work, where the number of operations required in any one chucking will permit completion of machining at four stations. An automatic chucking mechanism has been incorporated in the design of the machine to be used for such special chucks or fixtures as required.

All spindles are carried on preloaded roller bearings automatically lubricated with clean oil. Ball bearings are used as required throughout the machine. In order to meet tooling conditions, a variety of standard tool heads can be had. The plain vertical tool head is of one-piece construction of sufficient width to accommodate duplex tooling and has 6 in. vertical movement only. The plain compound tool head is a single tool slide mounted on a saddle, and also accommodates duplex tooling. Total stroke of this plain compound head is 6 in., which may be applied as vertical movement only or to include a maximum movement of the tool slide of 3 in. horizontally, either right or left. Where tooling requirements are such that neither the plain vertical nor plain compound tool heads may be applied, the universal tool head may be used. Total stroke of 6 in. may be applied as vertical movement only or to include a maximum of 3 in. horizontal or angular movement. Like the other slides, this will also accommodate duplex tooling.

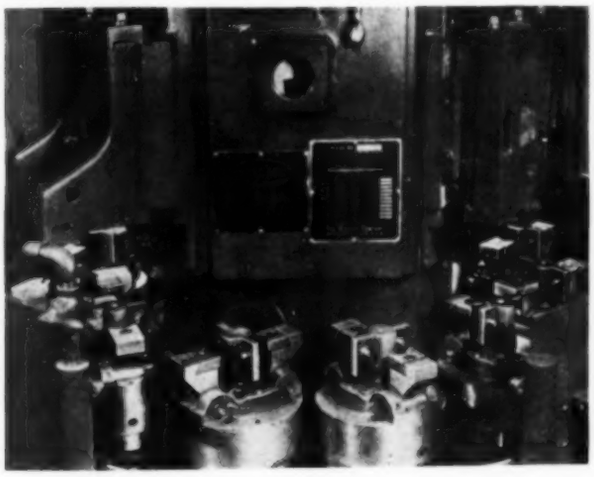
For work requiring drilling operations, duplex live-spindle drillheads may be applied at any working station. Variable independent spindle speeds on these drillheads may be obtained by change gears. Where multiple drilling is necessary, heads can be supplied.

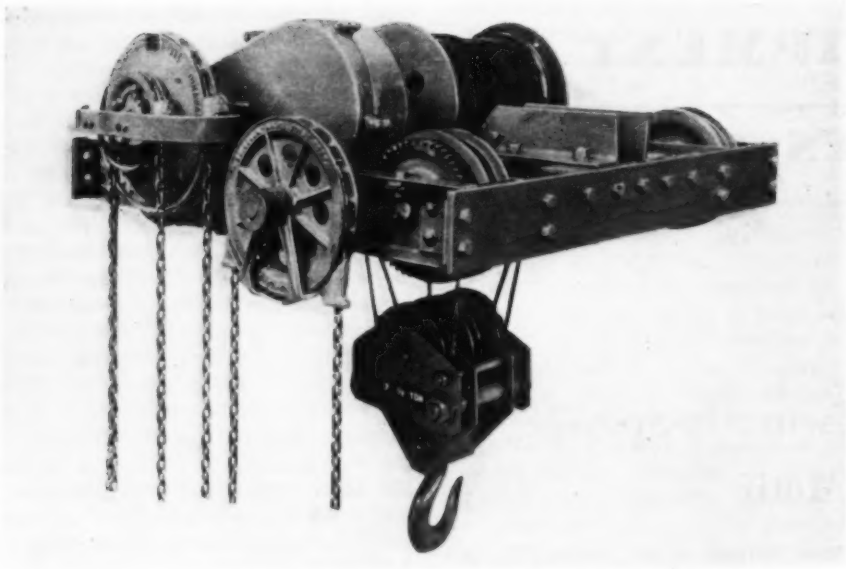
The Type F has a base machine weight of 18,000 lb., with a projected floor space of 63 in. in diameter, plus space of 43x20 in. for the chip pan. Height from the floor to the motor base is 124 in. Motor horsepower, according to work requirements, may run up to a maximum of 35. Heavy construction and the use of heat-treated alloy steel and alloy castings fit the machine for heavy cuts and smooth operation.



Doubled capacity is secured in Bullard Type "F" Mult-Au-Matics by mounting two chucks at each of the six stations. A high-speed and a low-speed model are offered

Close-up of the chucks from the loading station





Built in capacities from 3 to 30 tons, the "Cyclone" 2-Speed Drum Hoist is suitable for limited headroom and maximum lift

"Cyclone" 2-Speed, Wire-Rope Drum Hoist

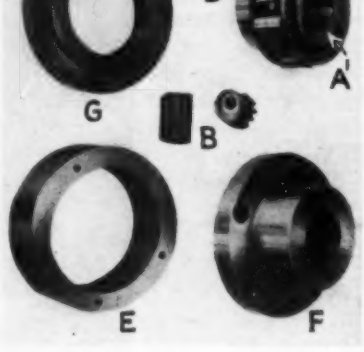
A compact combination of a "Cyclone" wire-rope hoist and a geared structural carriage has been developed by the Chisholm-Moore Hoist Corp., Tonawanda, N. Y., for limited headroom and maximum lift. The hoist is for use on a double I-beam, overhead traveling crane. The unit is equipped with dual chain sheave and two pendant hand chains. The larger sheave provides low-speed ratio for capacity loads; the smaller sheave providing high-speed ratios for light loads. Capacities of the hoist range from 3 to 30 tons. A Weston-type disk brake assures load holding capacity and control. Fourteen ball and roller bearings are included in the hoisting mechanism; an anti-friction bearing at each rotating point. Hoisting mechanism operates in a grease bath in an oil-tight housing. The hoisting unit employed is regularly used in the "Cyclone" Model K chain hoist. The gears have machine cut teeth.

Kelpo Free-Wheeling Clutch

The Kelpo Clutch Co., 216 Mill St., Rockford, Ill., has taken over the one-way or free-wheeling clutch from the Engineer's Specialty Co., Chicago, and is now manufacturing a redesigned line. The tooth form used is now special, and the number of cams employed has been increased to increase the life and factor of safety of the clutch. The complete line now includes standard clutches up to 10 in. shaft diameter.

Construction of the clutch can be seen from the accompanying illustration. The clutch coupling consists of a drive gear *A*, a set of cam gears *B* mounted in a cage *C*, a set of springs *D* and a case comprised of ring *E*, drive flange *F* and cover *G*. Drive gear *A* is mounted on the prime mover shaft and meshes with the set of cam gears *B* mounted in the cage *C*. This assembly is contained in the case so that the cams engage the inner surface of the ring *E*. Drive flange *F* is mounted on the load shaft and has the ring *E* and the cover *G* bolted to it to make the complete case, which revolves with the load shaft.

When the drive gear *A* is rotated in the driving direction, it turns the cams in such direction that they grip the case and drive the load. When the load shaft rotates faster than the prime mover shaft, the clutch free-wheels, cams allowing the case to slip past them freely.



More special toothed cams in the Kelpo clutch increase the factor of safety

The springs serve only to keep the cams in contact with the ring *E* and ready to grip.

The Kelpo free-wheeling clutch may be assembled on the job to operate in either direction, depending on how the cam assembly is mounted on the drive gear. The clutch is satisfactory both as a free-wheeling coupling and also as a ratchet. When used as a ratchet, an arm is mounted on the drive gear *A* and hub *F* is mounted on the shaft to which the ratchet movement is to be imparted. When working as a ratchet, it will register accurately to within a few thousandths.

Janette RW-3 and RW-4 Speed Reducers

The Janette Mfg. Co., 556 W. Monroe St., Chicago, Ill., has added the Types RW-3 and RW-4 motorized speed reducers to its line. These units are identical in appearance and differ only in size. Between these two units it is possible to obtain motor horsepowers of from ½ to 5 hp. in polyphase or d.c. models, motor speeds being 1140, 860, 690 and 575 r.p.m. Twelve standard ratios range from 90:1 to 8:1.

Both these speed reducers incorporate worm gear reduction units and a ball bearing motor bolted directly to the gear housing. The worm is on the extended motor shaft, the outer end of which is supported by a third ball bearing. The slow speed shaft is supported by two tapered roller bearings. Eight mounting positions can be had.

Hanna Yoke-Type Compression Riveter

Aluminum alloy castings are used extensively in the construction of the yoke-type compression riveter recently developed by the Hanna Engineering Works, 1765 Elston Ave., Chicago, Ill. Other major parts are either hardened and ground alloy steel forgings or heat-treated alloy steel castings. As a result, the riveter is light and compact and thus suited for portable use. It weighs

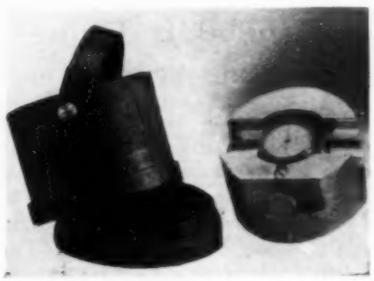
A pressure of 15 tons exerted by the Hanna Riveter will head 5/16-in. cold rivets

170 lbs., and develops a pressure of 15 tons bewteen the dies. This pressure is sufficient for heading 5/16-in. rivets cold. The mechanism is entirely inclosed and operates in a bath of oil. The yoke may be swiveled 360 deg. about the die axis and is quickly removable for interchanging it with yokes of other shape, reach and gap. Reach of the yoke illustrated is 3 in. and the gap is 3 in.

When suspended from a balancer, which is in turn suspended from a miniature crane, the riveter may be quickly and easily moved from rivet to rivet. Such an installation is suitable for assembly riveting of automobile chassis frames of the X-cross member design. This design involves box cross-section members with rivets that must be reached through holes in one web of the box. The chassis frame remains stationary while the rivets are driven.

Westinghouse Portable Vibrometer

Vibration studies on small machines can be undertaken with the portable vibrometer developed by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The instrument consists of



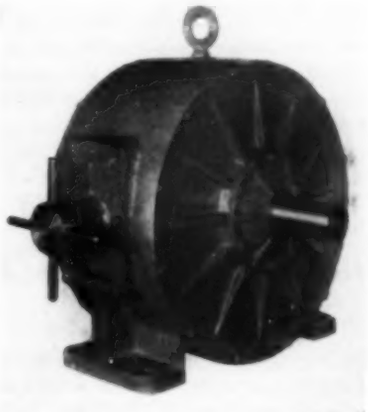
a flexibly supported mass and a dial indicator fastened to the end of a thumb screw and supported by the mass, to measure the amplitude. The vibrometer has been used for frequencies as high as 6,000 r.p.m., when the amplitude does not exceed 0.004 in.

Toledo Dynamic Weigher

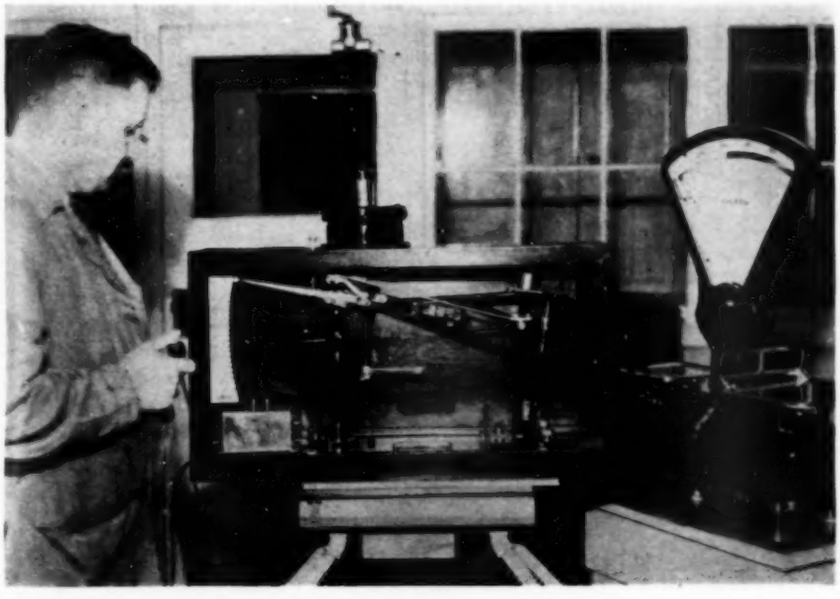
Toledo Precision Devices, Inc., Toledo, Ohio, has developed a dynamic weigher which classifies parts to close tolerances and rejects over-weight and under-weight parts. It is claimed that the weigher combines the speed of an automatic scale with the precision of a laboratory balance. It has been used for classifying pistons, bearings, valves, cams and other reciprocating and rotating parts. The scale determines the mass of an article or commodity by measuring inertia while the scale is in motion — hence the name, "Dynamic Weigher." Speed of weighing is obtained because it is unnecessary to wait for the scale indicator to come to rest. Articles weighing several pounds can be measured to an accuracy of a few grains. If desired, an electric eye can be furnished to increase the speed of classifying operation.

Northern Series 5000 Rotary Pumps

A complete line of hydraulic pumps and motors of the rotary, radial piston type has been placed on the market by the Northern Pump Co., Minneapolis, Minn. This Series 5000 line is available in sizes from 1 gal. per minute to 200 gal. per minute, and pressures up to 4,000 lb. per sq. in. The volume of discharge can be varied from zero to the maximum capacity of the pump. A complete line of automatic controls and semi-automatic valve mechanisms is also available. All pumps are fitted throughout with Nitralloy parts for wear resistance, particularly in the presence of dirty oil. Sensitive control of speed is secured by the pump discharge regulation. Smooth action is secured because of the hydraulic automatic control.



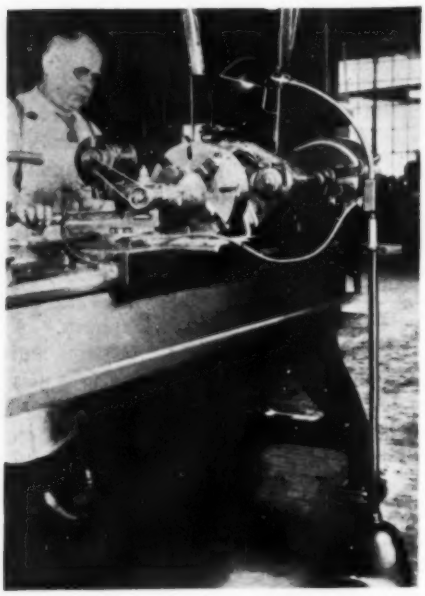
Northern Series 5000 Rotary Pumps are built in six sizes covering the range from 1 to 200 gal. per min. Automatic controls replace the hand control without machining



Speedy classifying of parts for under-weight or over-weight with the Toledo Dynamic Weigher arises from determining the mass by measuring inertia while the scale is in motion. The indicator does not have to come to rest. An electric eye increases the speed of the classifying operation

Appleton Portable "Adaptalite" Lighting Fixture

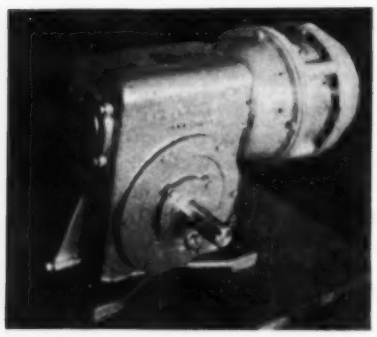
The Appleton Electric Co., 1701 Wellington Ave., Chicago, Ill., has placed on the market a portable lighting fixture known as the "Adaptalite". It is shown being used over a lathe. A heavy metal



base and upright standard, which can be raised or lowered, with a flexible arm and half reflector comprise the fixture. The base has a reel with 15 ft. of rubber-covered cord. A duplex outlet makes it possible to plug in an electric drill or an electric grinder.

Boston Motorized Speed Reducer

Unit design is a feature of the motorized worm gear speed reducer announced by the Boston Gear Works, Inc., North Quincy, Mass. The speed reducer has been especially designed in combination with a standardized motor to form a compact power unit. The worm and motor shaft are made integral to afford quietness and positive alignment. All models are equipped with G.E. motors, but other makes of motors may also be used economically where the complete assembly is produced in quantities. These speed reducers are available in various sizes from ¼ to 3 hp., and in driven shaft speeds of 11 to 172 r.p.m.



Yale High-Lift Tilting-Frame Truck

An electric truck that will pick up loose and bulky loads directly from the floor for transportation in a tilted position to storage has been developed by the Yale & Towne Mfg. Co., Philadelphia Division, Philadelphia, Pa. This Model K31A truck is rated at 4,000 and 6,000 lb. It has a short wheelbase and low center of gravity and provides stability. Triple-reduction, spur-geared power units are used for both hoisting and tilting. One unit tilts the upright frame either 4½ deg. forward or 25 deg. backward through two heavy-duty racks and driving pinions. The other unit elevates the vertical traveling carriage by means of sprockets and two standard roller chains. Dual tilting and hoisting control handles are arranged on both sides of the operator's platform. Controller is of the interlocking type with four speeds forward and four speeds reverse. Standard over-all height of the truck is 83 in.

Round "Auto-Bloc" Chain Hoist

Anti-friction bearings are used throughout the "Auto-Bloc" chain hoist announced by David Round & Son, Cleveland, Ohio. Either Timken roller bearings or ball bearings are employed. The hoist is compact and made in capacities from ½ to 20 tons. It incorporates hardened and ground gears of drop-forged alloy steel. Alemite-Zerk fittings provide pressure lubrication to all bearings. If the pockets in the load sheave become worn in one direction, the sheave may be reversed. An electrically welded steel chain is provided.

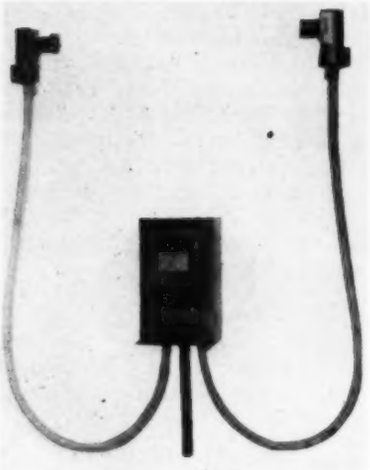
Compactness and low weight are found in the "Auto-Bloc" Hoist

Westinghouse "Photo-Troller" Photoelectric Controller

Developed for the field of light sensitive control by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., the "Photo-Troller" device can be actuated by a phototube or by delicate contacts carrying only a few micro-amperes. Due to its flexibility and low cost, the device is adapted to applications such as counting, limit switches and automatic weighing.

The phototube, or sensitive contact, operates a grid glow tube, which in turn closes a contactor capable of initiating any desired operation. Delicate inter-

Through heavy-duty racks, pinions and power-reduction units, the upright frame of this Yale truck is tilted 4½ deg. forward or 25 deg. backward



Flexibility makes the Westinghouse "Photo-Troller" desirable for many control uses

mediate relays are eliminated and greater reliability is secured. The Photo-Troller is assembled in a sheet metal cabinet. Units are available for any commercial voltage or frequency, except d.c. The device contains a complete power supply for all auxiliaries, including the light source.

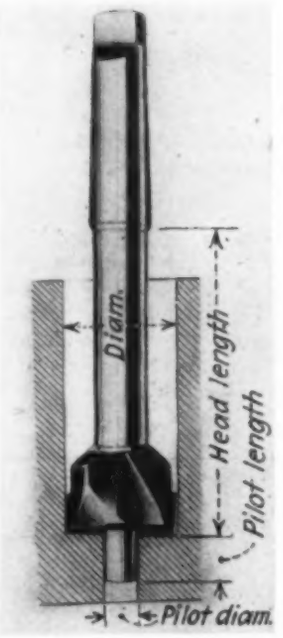
Yale High-Lift Swinging Boom Crane

In the high-lift swinging boom crane truck developed by the Yale & Towne Mfg. Co., Philadelphia Division, Philadelphia, Pa., the swinging boom and hook are suitably mounted on large diameter rollers so that the boom can be swung by hand 45 deg. from the center line in either direction. The crane has a capacity of 1,200 lb. in any position. Due to the high lifting features of this crane, the hook can be varied from a height of 33 to 102 in., depending on the over-all truck height, without changing the boom outreach.

Three-point support by the Wade Knurling Tool assures correct knurling of long, slender work

Wade Knurling Tool

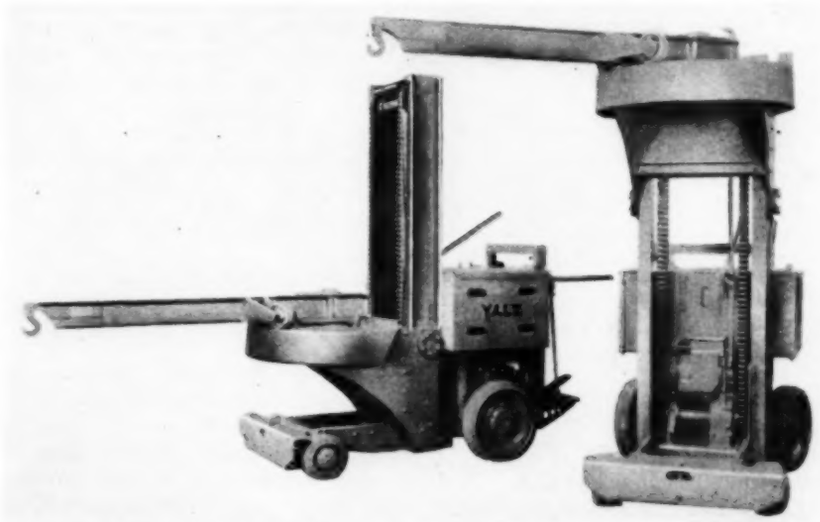
For knurling long or slender work, the Wade Tool Co., Waltham, Mass., has developed the tool illustrated. Such work needs to be supported against the high pressure of knurling. Consequently, the tool incloses it between three points. The tool can be brought into action speedily without adjusting it in the toolpost. The knurl is fed into the work by means of a screw on the handle. The plunger that carries the knurl is keyed so that it cannot turn. A coarse and a fine set of diamond knurls is furnished with each knurling tool, the extra set being kept in the hollow handle. The tool is 7 in. long. Maximum capacity is ¾ in. in diameter; minimum capacity, $\frac{3}{32}$ in.



O. K. Deep-Hole Counterbores are made in nine diameters from 1½ to 6 in.

O. K. Deep Counterbore

To bore deep holes, the O. K. Tool Co., Inc., Shelton, Conn., has developed a two-bladed counterbore. It is said that the ordinary multi-bladed boring tool, although suitable for shallow operations or where a small amount is left for finishing, is unsuitable for breakdown or roughing operations. When a hole is of some length and considerable metal must be removed, the construction as shown is employed. The two adjustable O.K. cutter blades are inserted into a forged and heat-treated alloy steel body. The blades interlock with a pilot, which guides the tool through the bore. Chips readily pass out of the hole because the body of the tool is cut away. Tools between 1½ and 6 in. in diameter are offered. Cutter blades are drop-forged high-speed steel, super-cobalt high-speed steel, J-Stellite, or cemented carbide.



With capacity of 1,200 lb., the Yale Swinging-Boom Crane has a lift ranging from 33 to 102 in., depending on the truck height

Madison-Kipp "Blue Midget" Air Grinder

An air grinder weighing only 7 oz. and running at 40,000 r.p.m. has been placed on the market by the Madison-Kipp Corp., Madison, Wis. This grinder is small enough to conceal in the palm of one's hand. Known as the "Blue Midget," the grinder has been developed

For light work, the "Blue Midget" Air Grinder weighs only 7 oz.

for light work and intermittent service. Included with the model are 8 ft. of air hose, grinding wheel, a bottle of Kipp oil and the Kipp syringe-type pressure oiler. All air tool accessories and wheels having ⅛-in. diameter shanks can be used with the Blue Midget.

• PATENTS •

JANUARY 10, 1933

Metal-Working Machinery

Grinding Machine. William H. Chapman, Montclair, N. J., assigned to General Motors Corp. Patent 1,893,837.

Tool Mechanism for Gear Cutting Machines. Magnus H. Johanson, Rochester, N. Y., assigned to Gleason Works. Patent 1,893,943.

Sheet Metal Press. Otto Kuhner, Goppingen, Germany. Patent 1,893,951.

Drill Press. Cortis F. Sherman, Hartford, Conn., assigned to The Henry & Wright Manufacturing Co. Patent 1,893,965.

Drill Press. Frederick C. Allen, Hartford, Conn., assigned to The Henry & Wright Manufacturing Co. Patent 1,894,214.

Tools and Attachments

Article Feeding Machine. Philip H. Hutchinson, Montclair, and Joseph Klopak, Newark, N. J., assigned to General Motors Corp. Patent 1,893,839.

Copying Mechanism (Turning). Oskar Waldrich, Siegen, Germany. Patent 1,893,916.

Machine Center. Thomas Kerr, Schenectady, N. Y., assigned to General Electric Co. Patent 1,894,101.

Processes

Grinding Method and Means. Theodore B. Smith, Great Neck, N. Y., assigned to John Hassall, Inc. Patent 1,894,067.

JANUARY 17, 1933

Metal-Working Machinery

Cam and Like Grinding Machine. Llyweln Mawer, Bishopston, Bristol, England, assigned to The Churchill Machine Tool Co., Ltd., Manchester, England. Patent 1,894,382.

Apparatus for Mechanical and Heat-Treatment of Metal Articles. Roy C. Ingersoll, Galesburg, Ill., assigned to Ingersoll Steel & Disc Co. Patent 1,894,590.

Feed Mechanism for Swaging Machines. Eric L. Stowe, Torrington, Conn., assigned to The American Brass Co. Patent 1,894,800.

Tools and Attachments

Die Head. Harry T. Shearer and Charles A. Reimschissel, Waynesboro, Pa., assigned to Landis Machine Co. Patent 1,894,296.

Hydraulic Control Device. Larkin R. Williamson, Toledo, Ohio, assigned to The Toledo Machine & Tool Co. Patent 1,894,434.

Welding Clamp. Edward G. Todt, Chicago, Ill. Patent 1,894,454.

Header Mechanism. Richard Lester Wilcox, Waterbury, Conn., assigned to The Waterbury Farrel Foundry & Machine Co. Patent 1,894,526.

Cam Milling Attachment for Lathes and Other Machine Tools. Ernest J. Svenson, Rockford, Ill. Patent 1,894,719.

Automatic Chuck Operating Device. Frank Krejci, Chicago, Ill. Patent 1,894,773.

JANUARY 24, 1933

Metal-Working Machinery

Pressure Welding Apparatus. Frank J. Brown, Washington, Pa., assigned to National Wrought Iron Annealing Box Co. Patent 1,894,938.

Multiple Spindle Lathe. Arthur J. Lewis, Stratford, Conn., assigned to The Baird Machine Co. Patent 1,895,078.

Work Spindle Drive for Chucking Machines. Arthur J. Lewis, Stratford, Conn., assigned to The Baird Machine Co. Patent 1,895,079.

Milling Machine. Newman M. Marsilius, Bridgeport, Conn., assigned to The Producto Machine Co. Patent 1,895,333.

Cam Miller. Newman M. Marsilius, Bridgeport, Conn., assigned to The Producto Machine Co. Patent 1,895,334.

Tools and Attachments

Tool Holder. Rudolf Von Frommer, Budapest, Hungary. Patent 1,895,057.

JANUARY 31, 1933

Metal-Working Machinery

Automatic Welding Machine. Earl W. Little, Indianapolis, Ind. Patent 1,895,577.

Automatic Die-Casting Apparatus. Karl Friedrich Wagner, Stuttgart, Germany, assigned to Magnesium Development Corp. Patent 1,895,596.

Hydraulic Press. Walter Ernst and Howard F. MacMillin, Mount Gilead, Ohio, assigned to The Hydraulic Press Mfg. Co. Patent 1,895,710.

Worktable and Relieving Mechanism for Grinding Machines. Ernest A. Walker, Worcester, Mass., assigned to John Bath. Patent 1,895,830.

Tools and Attachments

Internal Driving Fixture. John E. Lovely, Springfield, Vt., assigned to Jones & Lamson Machine Co. Patent 1,895,807.

Processes

Method of Forming Diamond Charged Cutting Tool Bits. Samuel L. Hoyt, Schenectady, N. Y., assigned to General Electric Co. Patent 1,895,926.

• TRADE PUBLICATIONS •

CHAIN. Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill. Book No. 1457 on "Silverlink" Roller Chain is a combined list price catalog, stock list, and engineering data book. It tells how to figure, apply, install, lubricate and maintain roller chain drives. A section lists complete drives available from stock.

GEARS. Spaulding Fibre Co., Inc., Tonawanda, N. Y., has issued a bulletin on engineering and design information for gears cut from Spauldite laminated phenolic resin gear stock. The gears are of the silent variety for running with metal companion gears.

PLANT EQUIPMENT. Industrial Plants Corp., 25 Church St., New York, N. Y., is distributing a catalog listing equipment being offered in liquidating the foundry, machine shop and pattern shop of the Cresson-Morris Co., of Philadelphia, manufacturers of machinery and transmissions.

MONEL METAL. Bulletin T-5, issued by the Development & Research Dept., International Nickel Co., Inc., 67 Wall St., New York, N. Y., is entitled "Engineering Properties of Monel Metal."

WELDING. A report of an investigation conducted by The Engineering Experiment Station, Purdue University, in cooperation with The Utilities Research Commission, Inc., is entitled "Welding with Manufactured, Natural, and Mixed Gas." It is known as Research Series No. 41 and the price is $0.50.